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THE GENERAL ELECTRIC COMPANY'S ANNUAL REPORT.

Nothing of a very interesting character can be found in the fifth annual report of the General Electric Company, covering the results of its operations during the year ending January 31, 1897, of which an abstract appeared in our last issue. The management is to be commended for making the report public about a fortnight in advance of the annual meeting of the stockholders at Schenectady on May 11. The opportunity thus afforded for examination of the figures and facts submitted is not, however, likely to create criticism as to either policy or results, since the showing corresponds very closely with what was already expected in both electrical and financial circles. The fact that the report has been without any effect on the position of General Electric's shares in the market is an indication that its negative character had been well understood.

In fact it might be remembered that the matter in connection with General Electric which has the greatest interest for Wall Street (and State Street, Boston, also) is not referred to, even indirectly, in the report. This is the possible arrangement of the capital impairment, and a settlement of the cumulative dividends of 7 per cent. per annum upon the preferred stock. Rumors that plans for dealing with these questions have been under consideration are heard from time to time, but the past year could certainly not be considered suitable for financial operations of such a character.

The year's report of the company would, however, indicate that progress has been made towards strengthening the company's financial position. In this respect the report produces a favorable impression. It opens with due reference to the disturbed financial and political situation of the past year, and to the curtailed supply of capital available for the establishment and extension of electrical enterprises, with its corresponding effect on the company's business. In spite of this, however, the gross earnings of the year—$12,820,395—decrease only $495,272 from the figures of the preceding year, while expenses—$11,207,388—represent a reduction of $552,469, so that the surplus over expenses and interest on the debentures, taking into account $370,479 of interest and dividends on securities owned, is $1,552,236 for the year, or $163,269 more than the same item a year ago. Deducting from this $592,578, the net amount written off for losses, for patents acquired and for reductions of inventories, the result is a balance of $959,658. This applied to the deficit of former years reduces that item, which in the main represents the impairment of capital, to $12,957,413.

It is, however, satisfactory to notice that almost all the surplus income was devoted to the retirement of the company's debentures, of which $750,000 were taken up and cancelled, leaving $8,000,000 now outstanding. The year, of course, was not favorable for sales of securities, but stocks and bonds held in the treasury, of a par value of $326,115, were sold for $285,829. Mainly through settlement of old indebtedness $5,274,950 of additional securities were acquired, resulting in an increase of $3,066,463 in an item of bonds and stocks held which now amounts to $8,545,795. It is also stated that the company has no floating debt, and that its accounts payable, amounting to $492,264, represent merely current bills and vouchers.

RAPID MACHINE TELEGRAPHY.

The very interesting paper by Mr. A. C. Crehore and Lieut. George O. Squier, in another column, presents some radical innovations in telegraphic methods. There can be little doubt of the ingenuity and beauty of the methods described by these authors, but there is a considerable question as to the actual value of any such system of rapid telegraphy as they indicate.

The difficulty with all such systems is that, while the transmission of signals between the termini of the line is rapid, the preparation of the signals for transmission and their subsequent translation at the receiving end occupy quite as much time as the ordinary Morse method of telegraphy. These difficulties, which are apparently considerable, have worked against the extension of machine methods in telegraphy in this country and elsewhere, although these have been known and in more or less successful operation for a considerable length of time. The desideratum in telegraphy is unquestionably that method which will require the least average time between the actual writing of the message in the place of business of the sender and its delivery in legible form in the hands of the recipient. It seems more than likely that the loss of time required by the translation of messages into a formal system of signals at the sending end and its transcription from the received signals into typewriting, or some other legible and easily read manuscript, for the benefit of the recipient, will more than compensate for the gain in time of actual transmission upon the wire.

Some very interesting figures are presented by Messrs. Crehore and Squier upon the volume of telegraphic and mail business in the United States and the relative costs of these methods of communication, and, from these conclusions are drawn relative to the utility of a system of rapid telegraphs. While it is true that such a system would result, as these authors have pointed out, in a great increase in the capacity of many lines, yet it is doubtful if it would prove as flexible as the methods now in use, or would as readily adapt itself to the requirements of ordinary business conditions. The telegraph and the long-distance telephone occupy distinct positions without appearing to encroach very much upon each other's territory. Where great haste in the transmission of intelligence is required, the long-distance telephone has come to be looked upon as the proper means, since a conversation with an interchange of questions and replies may be had by its agency in much less time than by the most improved machine telegraphic methods conceivable. At the same time the ordinary form of telegraph has proven its utility over and over again by the fact that a permanent record of the message sent is preserved through its agency at both the sending and receiving points. Whether the machine telegraph could find a field for itself intermediate between these two is hard to prophesy, but it hardly seems likely that business men could be induced to use the rather cumbersome method indicated by these authors for the preparation of their letters, or would universally employ operators skilled in the preparation of such messages.

THE FIRST ELECTRIC RAILWAY.

In another column is a very entertaining letter from Mr. Wm. H. Johnstone, who probably has the distinction of being the first electric railway passenger. The account of Robert Davidson contained in it gives a glimpse of the personality of this remarkable man, who built an electric locomotive nearly forty years before the first commercially successful attempts at electric traction were made.

It was in 1835 that Thomas Davenport exhibited his automobile electric car on a little circular track at the Boston Mechanics' Institute fair. This crude contrivance was, on a small scale, much the same as Davidson's "Galvani," which was operated on certain Scotch railways in 1840. The size and power of this machine far exceeded anything that had been attempted previously, and certainly entitled it to a more respectful consideration than it apparently received.

The fate of the Davidson motor furnishes a commentary upon the reception, at that time, of many meritorious inventions at once ludicrous and pathetic. The machine had been in experimental service some time on a steam railway, and had been so successful that the locomotive engine-men imagined it foreshadowed the loss of their employment. One night the motor returned to Perth and was stabled in the engine house of the railway. In the morning it was found broken to pieces and irreparably injured.

CONCERNING LARGE CITIES.

The Governor of New York State has just signed what is popularly known as the Greater New York charter, incorporating as one municipality the cities of New York, Brooklyn and Long Island City, together with Staten Island, Kings County, Queens County and part of Westchester County. The new city has a population of 3,200,000, and is consequently the second city in the world in this respect, as well as in area. With 1300 miles of streets, it has 156 miles of elevated railway and over 1000 miles of street railways.

It seems probable that the high-water mark of urban population is nearly reached. Each year has seen an increase in our large cities, more and more people flocking in from the surrounding country to aid the natural growth of population and swell the census figures. There is beginning, however, a movement on the part of many to seek homes in the adjacent suburban regions, wherever transportation facilities of the right kind exist.

With the improvement of these facilities there will be an enormous increase in the number of people who thus reside in the country and conduct their business in the city. The rapid extension and betterment of suburban transit railways already begins to show signs of affecting the population of the larger towns by decreasing the number of citizens who reside within their limits.

It requires no special gift of prophecy to foresee that this tendency to escape the discomforts of city residence will soon balance the attraction of the town for country-bred persons. With the ideal electric service of many and fast trains, now so nearly attained, the early part of the coming century must needs witness an extension of suburbs, a decrease in purely urban population, and an enormous growth of this branch of the transportation industry. It is thus within the province of electrical engineering, by providing the means of transit desired, to become a large factor in the betterment of hygienic and social conditions.

IMPROVEMENT IN RÖNTGEN RAY TUBES.

Two articles of especial importance concerning improvements in Crookes tubes for the production of Röntgen rays appear in this number. The method suggested by Mr. A. A. C. Swinton is exceedingly simple, and capable of such easy practical accomplishment that it promises to become popular with makers and users of such tubes. At best, however, this method is a makeshift, and does not provide for continuous operation of the tube for long periods.

The method presented by Mr. H. L. Sayen, however, is marked by great originality, and seems to be the most important advance in the construction of these tubes since Röntgen's discovery was announced. The extreme simplicity and certainty of operation which characterize it, and the fact that the tube is self-contained and remains immovable through long periods of operation, are points of great merit. The most important point, however, is the possibility of adjustment of the vacuum to any desired degree for the production of rays of various penetrative powers by one tube, and the automatic maintenance of these conditions.

Adjustable X-Ray Focus Tubes.

BY A. A. C. SWINTON.

As all who have had occasion to use X-rays for practical purposes are aware, the penetrative value of the X-rays produced by any given Crookes tube depends very largely upon the exact degree to which the tube has been exhausted. Further, as is well known, a tube originally exhausted to any particular vacuum is found in practice to alter its degree of vacuum with age and with use. With tubes of the Jackson focus type, that have been well exhausted in the first instance, the vacuum usually increases the more the tube is used, particularly if sufficient power is employed to heat to redness the platinum anti-cathode. Indeed, it is not unusual for this increase of vacuum to be such that it is eventually found impossible to get any discharge to pass through the tube at all. Various arrangements have from time to time been suggested and tried for the purpose of regulating the vacuum in tubes. One plan is to keep the tube permanently attached to the mercury pump, so that a little air can be pumped out or a little let in when ever it is found necessary. Another arrangement is to place some material, as for instance caustic potash, which is capable of absorbing air, and giving it out again when warmed, in a small pocket or annex to the tube, which can be heated by means of a spirit lamp, and the vacuum reduced as occasion requires. These, however, as also the ordinary plan of heating the whole tube by means of a spirit lamp or Bunsen burner, so as to drive off into the interior of the bulb the gases condensed upon the glass, are at best only makeshift expedients, which, though capable of good effect in the hands of skilled experimenters, are not permanent in their results or adjustable with sufficient accuracy to be really satisfactory.

Further, exceedingly minute alterations in vacuum will make all the difference between satisfactory and unsatisfactory results in some of the more difficult cases to which X-rays are now applied.

Under these circumstances the writer has devoted considerable attention to devising a method whereby the penetrative value of the X-rays produced by a focus tube could be easily varied without alteration to the vacuum, and whereby, further, the penetrative value of the rays could be maintained constant at any desired degree, in spite of the uncontrollable variations in the vacuum that are found to occur in practice.

A full account of the writer's experiments in this direction will be found in a paper entitled "The Production of X-Rays of Different Penetrative Values," recently read at the Royal Society, but here it is only necessary to mention two of the results obtained, namely, that the penetrative value of the rays for any given degree of vacuum depends, among other things, upon the area of the cathode disc, and upon the linçal distance between the cathode and

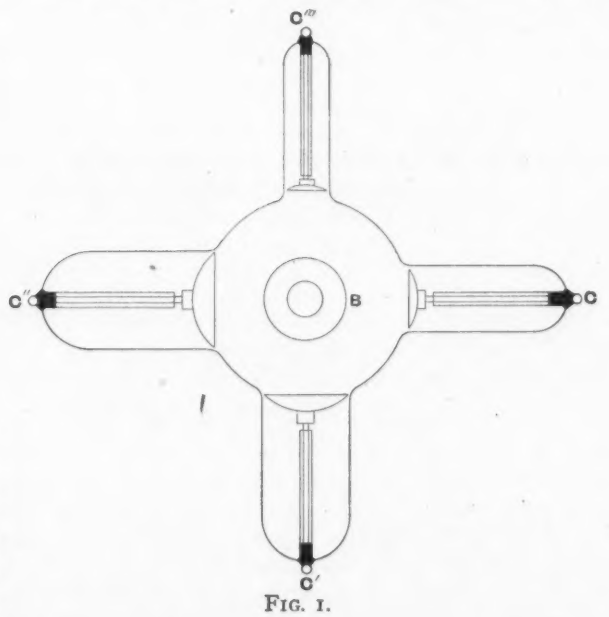


FIG. 1.

anti-cathode. Upon these principles the writer has designed two separate forms of adjustable focus tube, Figs. 1 and 2.

In the form of tube shown in Fig. 1 advantage is taken of the difference of effect produced by employing cathodes of various sizes. As will be seen from the illustration, the tube is provided with four concave aluminum cathodes, *C*, *C′*, *C″*, *C‴*, all of the same radius of curvature, namely, .75 inch, but of four different diameters, varying from .5 of an inch in the case of C to 1.125 inches in the case of *C‴*. The cathodes are so placed that they all focus on a point in the centre of the bulb of the tube, and the inclined anti-cathode disc *B* is mounted upon a small steel spindle, turning in aluminum sockets, so that the anti-cathode can be easily rotated by tapping the tube, so as to face any one of the four cathodes that it is desired to work with. The anti-cathode disc *B*, made of aluminum, is of considerable mass, being an oblique section about .25 of an inch in thickness, cut from an aluminium rod 1 inch in diameter. The cathode rays are not received direct upon the aluminium, but upon the surface of a disc of platinum about .6 inch in diameter, and about .025 inch in thickness, tightly wedged and riveted into a shallow circular depression turned out of the face of the aluminium block. The reason for the particular shape of the aluminium portion of the anti-cathode is to ensure its being balanced in all positions of the tube, so that it should have no tendency to rotate of itself. The object of the general arrangement is to prevent the platinum from attaining an excessive temperature, even when great electrical power is employed, this resulting from the considerable radiating surface of the aluminium, and its considerable mass requiring a long time to heat it up to any high degree. This arrangement makes the tubes take considerably longer to exhaust in the first instance, but renders them much more permanent, as not only is there no danger of melting the platinum, as frequently occurs in the ordinary form of anti-cathode, but also the difficulty experienced with the red-hot platinum occluding the residual gas, and thus increasing the vacuum, is largely done away with, while in addition, the platinum having only one surface exposed, and never getting very hot, the tubes do not blacken so quickly.

As will be seen from the illustration, the anti-cathode is sup-

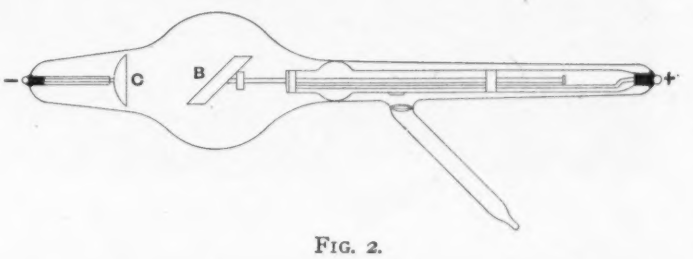


FIG. 2.

ported in a long double glass tube, through which passes an aluminum connection to the anode terminal. By this method great rigidity and accuracy are attainable, and the anode and cathode terminals are kept well apart.

During the process of exhaustion, it is necessary to make each of the cathodes operative in turn, so as to expel the residual gas, and finally the tube is exhausted to the necessary vacuum to produce X-rays of medium penetrative value, when one of the intermediate sized cathodes is in use. The tube is then sealed off, and afterward the penetrative value of the rays can be varied at will by turning round the anti-cathode so as to face any one of the cathodes, and making that cathode alone operative. The small cathode gives rays of the highest penetration, and the large cathode, rays of the lowest penetration.

With cathodes of the dimensions given, the range is very considerable. It can be diminished or increased by making the cathodes more nearly of one size, or the reverse. In place of the rotating anti-cathode, a fixed one may be used of four-sided pyramidical form, with a platinum disc let in on each face opposite to each cathode. The anti-cathode terminal need not be used as anode, as when one disc is cathode, the immediately opposite disc may be employed as anode.

The other tube, with which the penetrative value of the rays can be altered by quite a different method, is shown in Fig. 2. In this case the tube is fitted with but a single cathode *C*, and the anti-cathode *B*, which is of similar construction to that used in the other tube, is carried upon a steel rod which slides in two aluminium blocks, mounted in a glass tube and connected to the anode terminal. By slightly inclining and shaking the tube the anti-

cathode can be made to slide along in the bulb so as to alter the distance between the cathode and the centre of the anti-cathode from about one-half inch to 3 inches. Stops are provided upon the sliding steel rod to prevent its traveling too far in either direction. With a tube of this description it is found that the shorter the distance between the cathode and anti-cathode the higher is the penetrative value of the X-rays, and vice versa, so that by simply altering the position of the anti-cathode it is possible both to compensate for variations in vacuum, and also, within limits, to produce X-rays of any desired penetrative value.

The writer is indebted to the assistance of Mr. J. C. M. Stanton and Mr. H. L. Tyson Wolff, who made the tubes illustrated, as also all the earlier tubes with which the original experiments were carried out.

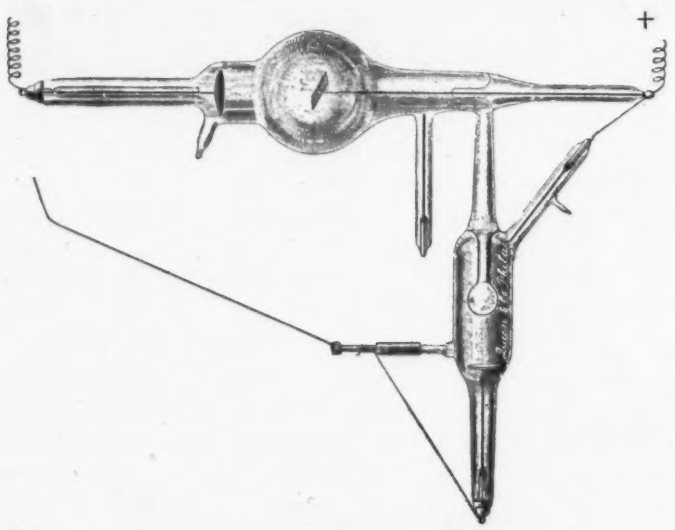
A Röntgen Ray Tube with Automatically Adjustable Vacuum.*

BY H. LYMAN SAYEN.

The most important and yet the most imperfect piece of apparatus that is necessary for the production of X-rays is the Crookes tube. It consists fundamentally of a cathode capable of focusing a stream of "radiant matter" upon a platinum plate, the whole being inclosed in a properly exhausted vessel.

Since the announcement of the focus tube in March, 1896, there have been few changes in the material arrangement of these parts. Many attempts, however, have been made to remedy one great defect which is inherent to Crookes tubes, and that is the gradual rise in vacuum subsequent to their constant use. I will briefly describe some of these methods and endeavor to show why they are inefficient.

Many makers provide their tubes with a little bulb opening into the main tube and containing potassium hydrate or other material which is capable of giving off gas on being heated. When the vacuum gets too high a spirit lamp is placed under the bulb and a small quantity of vapor is given off, which lowers the vacuum the desired amount. It has further been suggested to use a resistance coil around the bulb and to regulate the heat by means of an auxiliary source of current.



A Crookes Tube With Adjustable Vacuum.

Another scheme as suggested by Dr. William Morton, of New York, is to seal a small incandescent lamp on the main bulb, the two bulbs opening into each other, and to bring down the vacuum by passing an auxiliary current through the lamp filament.

Siemens & Halske, of Berlin, have recently put on the market a Röntgen ray tube in which the vacuum is adjusted in a most ingenious manner. A small bulb containing an internal electrode to which external connection can be made is connected to the main tube. This bulb contains phosphoric vapors which have the property of condensing when traversed by an electric current. To raise the vacuum the electrode of the bulb and the cathode are connected to the induction coil. Warming the bulb causes the phosphorus to revaporize and lower the vacuum.

*Abstract of a paper read before the Electrical Section of the Franklin Institute, Philadelphia, April 27, 1897.

In all these schemes the vacuum may be varied over wide limits and the life of the tube is increased to an indefinite extent, but as they all depend on the skillful manipulation of the operator it is seldom that they accomplish the desired result. The vacuum in a Röntgen ray tube can only vary over very small limits, and being also dependent on the temperature of the tube it is in a very unstable position. That is, if a tube starts to heat when running, the vacuum lowers and the tube takes more current, due to the increased conductivity of the gas therein, lowering the vacuum still more, while a reverse condition of affairs takes place if the tube cools. So it will be seen that it is very difficult and often impossible to keep the temperature of the tube constant and to manage the regulating device to produce the desired result. One way of using these devices is to lower the vacuum the desired amount and to keep it low by running with the platinum hot enough to keep the vacuum down.

The ideal regulating device should possess the following qualities:

First—It should act immediately.

Second—It should be independent of the temperature of the tube.

Third—It should keep the desired vacuum.

Having in mind the difficulties mentioned and the qualities desired Messrs. Queen & Co. asked me to proceed with a series of experiments in their laboratory, which have resulted in the device I will now describe.

A reference to the illustration will make the operation of this device clear. A small bulb containing a chemical which gives off vapor on being heated and reabsorbs it when it cools is directly connected to the main tube and surrounded by an auxiliary tube which is exhausted to a low Crookes vacuum.

In the auxiliary tube the cathode is opposite to the above-mentioned bulb, so that any discharge through it will heat this bulb. This cathode is connected to an adjustable spark point which may be placed at any desired distance from the cathode of the main tube. The main tube is exhausted to as high a degree as possible in the first place while running hot, and the chemical in the small bulb is rid of enough of its gas to insure its remaining high at all ordinary atmospheric temperatures.

In operating, the induction coil is connected as usual to the main bulb. On starting the coil, the vacuum of the main tube being high, the resistance is also high, and the current takes the path of the least resistance through the auxiliary tube, thereby heating the chemical in the small bulb. This will continue for a few seconds until a sufficient amount of vapor has been driven into the main tube to permit the current to go through it. After this only an occasional spark will jump across the spark gap to maintain the tube at the same vacuum. The vacuum may be set high or low by placing the spark point a considerable distance from or close to the cathode of the main tube.

I have here before you on the table a tube of this pattern connected to a large induction coil specially constructed for Röntgen ray work. The coil gives a 14-inch spark and runs in a most quiet manner on the 110-volt circuit. By means of a resistance in the base I can regulate the current in the primary to any amount desired up to the limit of the coil. This fluorescent screen, behind which I have placed a thick book, will show any difference of penetrability of the Röntgen rays due to difference of vacuum. On starting the current you see the main tube remains dark and the spark jumps across the spark gap. Almost immediately the large tube lights up. It is now possible to increase the current and you can see that it is possible to get the platinum anode brightly incandescent without lowering the vacuum in the least, as shown by the brilliant fluorescence on the screen. I shut off the current and bring the spark points together; on starting the coil the main tube lights up at a very low vacuum, so low that there is no fluorescence produced at all.

The tube has now the characteristic appearance of running on an alternating current. The reason for this is that the resistance of the tube is so low that the secondary of the coil is practically short-circuited, and by its mutual induction decreases the self-induction in the primary, allowing the current to rise more quickly on the make, producing considerable current in the secondary in the reversed direction. This effect is not so noticeable on battery circuits because the impressed E. M. F. is not so high on the make. I will not run much current through the tube at this point, be-

cause it blackens the bulb considerably, due to disintegrated platinum when the platinum becomes the cathode.

If I put a short spark gap in series with the tube and secondary you will notice that the alternating effect disappears, and it is now perfectly safe to increase the current. I should advise all experimenters who desire to keep their tubes from blackening, that in using tubes where the platinum is the anode (and with the platinum as the anode we undoubtedly get better X-rays), to use a similar spark gap in this manner. The sparking distance should be greater than the coil will spark on the make, and it is especially desirable when it is necessary to run on low vacuum with a 110-volt primary.

On separating the spark points, you see the vacuum rises slowly in the main tube until the spark prefers to jump across the gap. The tube now runs quite steadily without flicker, a small intermittent spark being sufficient to keep the vacuum down.

I will now connect the coil to the heating tube only and run it lightly for a few seconds, so as to drive considerable gas into the main tube. On connecting again to the main tube it will be noticed that the vacuum is so low that the gas is simply a conducting stream between the terminals, such as we recognize in a tube exhausted to a couple of millimeters of mercury.

Supposing we assume, after Sir William Crookes, that the vacuum necessary to produce X-ray effects is about one-millionth of an atmosphere (this is a low enough assumption at any rate), this bulb then contains enough gas to fill this whole hall at that high vacuum, so that the life of such a tube, barring misuse, should be practically unlimited. From even this most severe treatment the tube rapidly recovers and is now working in its normal state.

I will conclude my paper this evening with a brief summary of the advantages which I think a tube of this kind possesses over the ordinary type.

First—Adjustable vacuum: It may be set at any vacuum desired, from one so high that no current will penetrate it, to one so low that the current would rather go through the tube than jump over a parallel spark gap of one-half an inch. In a radiograph of the hand, for instance, it is desirable to use a low vacuum to secure the necessary contrast between bone and flesh, while in locating foreign metallic bodies in dense tissue it is desirable to use a high vacuum.

Second—Automatic regulation: At whatever vacuum it is set it will remain, so long as the coil is running, without any attention whatever from the operator.

Third—It will stand considerable energy without decrease of vacuum, consequently shortening the time of exposure necessary.

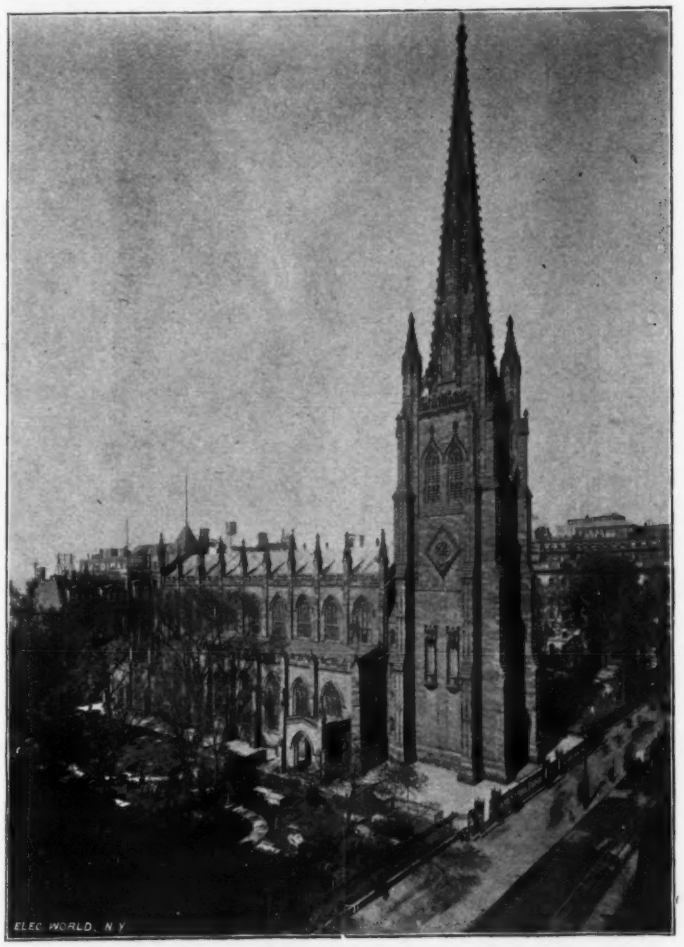
Prof. Arthur W. Goodspeed, of the University of Pennsylvania, has taken his best radiograph of the hip in three minutes with one of these tubes. He has also taken an excellent one in one minute. Dr. Wm. M. Sweet, with the tube adjusted at high vacuum, has located foreign bodies in the eye, the pictures being taken perpendicularly across the head, with an exposure of thirty seconds.

Fourth—A long lease of life.

The Bi-Centennial Celebration Decorations in Trinity Church, New York City.

During the week from Monday, May 3, to Saturday, May 8, one of New York's oldest religious organizations, Trinity Church, located on lower Broadway, opposite Wall Street, celebrated the bicentennial of its existence. Two hundred years previous to Wednesday, May 5, saw the birth of this now world-renowned ecclesiastical institution. From almost insignificance it has developed into one of the wealthiest and most famous of all religious bodies. It is, therefore, but fitting that in commemoration of the two hundredth year of its existence the congregation should make extraordinary efforts to fittingly celebrate this momentous event, and it may well be said that the grandeur and elaborateness of the arrangements are certainly not only unique, but pre-eminent among all others of the kind.

The enrichment of the interior of the church has been carried out with a most lavish hand, over $20,000 having been spent for appropriate and fitting decorations, all of which were specially designed and placed with peculiar skill, so that not a nail was driven into the structure at any point. The entire decorative features comprised a great variety of specially embroidered silk banners, iron shields and medallions, emblazoned with the arms of various religious and historical bodies. At the upper end of each of the large piers supporting the main arches running the entire length of the church and dividing the naves from the main aisle, is a specially placed platform which supports a winged figure, holding in



TRINITY CHURCH.

each hand an incandescent lamp, shaded by globes shaped like water-lilies. These figures were cast from a model made by Mr. A. St. Gaudens. They form electroliers of a most novel design. Between these figures are illuminated beams, each inscribed with a biblical text, and having fixed to the centre and each end thereof variously decorated shields. The previously mentioned banners are made in applique, wrought with designs symbolizing the chief festivals of the church year. Two banners hang from each of the fourteen illuminated beams, of which there are seven on each side, one over each pier arch. The top of the beams from which the banners hang supports a line of ten incandescent lamps fitted to bracket arms, five of which are placed at suitable intervals on each side of the central shield. The incandescent lamps are screened from view by translucent white fleur-de-lis shades, making the texts on the beams readable from the floor of the church. The platforms supporting the winged figures representing angels, previously mentioned, are 40 feet above the floor surface of the church. The illuminated beams are probably 60 feet. About half way down each of the main piers are four lanterns, each of which is on a separate staff and encloses an incandescent lamp. These lanterns were modeled after those used in the Middle Ages. Two are placed on the side of each pier, facing the main aisle, while the other two are on the nave side of each pier.

Nearly 250 16-cp incandescent lamps were used for the electrical decorations. The wiring was entirely temporary and included a No. 4 B. & S. main line from the service on the ground floor to the rear organ loft, where it was divided into two mains through a cut-out. Each main ran on porcelain insulators over the roof of each nave, and opposite each of the illuminated beams and winged figures a branch tap was taken through a cut-out and run to each section of lights, including the winged figure, pier

lanterns and illuminated beam. The wires were brought to the winged figures through a hole in the back and passed from thence to each hand and there connected to an ordinary socket.

It may be particularly noted that the entire decorative work, which was under the direct supervision of and installed by Mr. H. Duckworth Bayne, was placed without driving a single nail into any part of the structure, or in any way defacing or altering any fixture. When

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DECORATIVE ELECTROLIER, TRINITY CHURCH.

it is considered that the previously mentioned figures, beams and other devices were extremely heavy, and had to be supported about 50 feet in the air, the accomplishment of this task certainly necessitated the most skillful engineering. The hanging of the platforms supporting the figures was accomplished by tying a cable around the wall in the upper arch from window to window. This necessitated simply taking out a small piece of stained glass in each of the windows above the pier arches. The cable was fastened to a bar from which the platform was hung by means of steel cables run along the side of the piers. The illuminated beams were hung between these supporting bars, one end of each beam being supported by one of the bars,

Another unique feature necessitated by the peculiar conditions under which the work was installed, was the use of a temporary telephone service between the floor and roof of each of the naves. This was necessitated through the impossibility of carrying on conversation, owing to the fact that the windows in the main aisle arch are permanently closed. As an example of special decorative work in which the electric light played an undoubtedly important part the above is certainly unique.

American Association for the Advancement of Science.

Reports received at the meeting of the council of the American Association for the Advancement of Science, held at Washington, April 21, indicate a most encouraging outlook for the success of the approaching Detroit meeting. The permanent secretary, Prof. F. W. Putnam, stated from observations recently made by him at Detroit that all accommodations will be far more ample and commodious than at any previous meeting. It has often been difficult to accommodate the nine sections of the association in close proximity, and especially so to consolidate all the meetings under a single roof. The new High School Building has rooms enough, however, and it has also a hall capable of seating 2,500 persons; so all the exercises of the meeting, both general and sectional, will be held in this building. Ample hotel accommodations have been arranged for, the new Cadillac Hotel having made a reduced rate.

The invitation from the secretary of the British Association to the members of the American Association to participate in the Toronto meeting of the former was accepted, and a reciprocal invitation extended. Members of the British Association may become honorary members of the American Association upon enrollment of their names when present at a meeting, without further formalities.

The council met in circumstances of unusual bereavement. President Cope had died only nine days before the meeting, and just three weeks after signing the call convening the council, being the first president of the association who ever died during his term of office. Prof. Theodore Gill, as senior vice-president, under the provisions of the constitution, succeeds to the office for the unexpired term; and as Professor Cope had not yet prepared his annual address for the Detroit meeting, Professor Gill was requested by the council and consented to prepare, as the presidential address, an obituary notice of the late president.

G. Brown Goode, vice-president for the section of zoology, and B. A. Gould, one of the past presidents and auditors of the association, have also died since the Buffalo meeting. Leland O. Howard was nominated to succeed Professor Goode; and S. C. Chandler was elected auditor.

Secretary Putnam announced that arrangements were in progress to have the general excursion consist of a sail on the lake from Detroit to Buffalo, after the close of the meeting, and to continue the excursion to Niagara Falls and Toronto, reaching that city the day before the meeting there of the British Association. By leaving Detroit on the morning of Saturday, August 14, ample time would be available to carry out this programme.

The large attendance at the meeting of the council, and the spirit of harmony manifested, augurs well for the approaching meeting, which ought to be a notable one in the annals of our association.

Opening of the Tennessee Centennial Exposition.

An interesting ceremony took place at the executive mansion in Washington on May 1, in connection with the opening on that day of the Tennessee Centennial Exposition at Nashville. At 1:13 o'clock in the afternoon President McKinley touched a key which closed an electric circuit and set the machinery in motion at the exposition. When everything was in readiness the following telegram was handed to the President:

To President McKinley, White House, Washington, D. C.:

The people of Tennessee send greetings and request that you now put in motion the machinery of the Tennessee Centennial Exposition.

J. W. THOMAS.

After reading the dispatch, President McKinley stepped to the key, placed his fingers on the button, and electricity did the rest. Immediately afterward, the operator at Nashville sent back the signal "gx" which is the telegraphic abbreviation for "great excitement." "The people are wild in their enthusiasm," he continued. The President then sent the following message to Mr. J. W. Thomas, president of the exposition:

I congratulate the people of Tennessee upon the successful opening of their centennial exposition, and wish for it the greatest possible success.

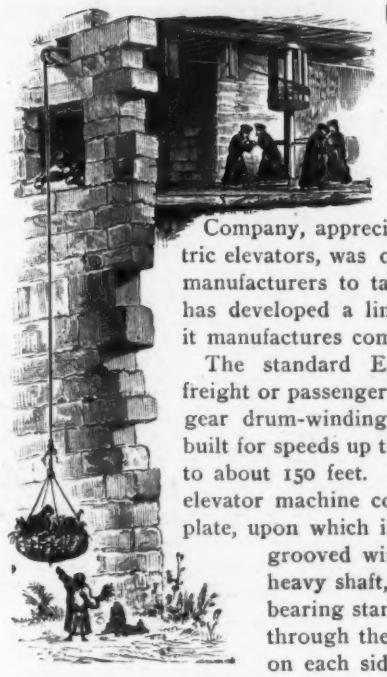
Several prominent gentlemen, including representative Tennesseans, witnessed the simple ceremony at the White House.

The Telegraph on the Baltimore & Ohio Railway.

Some interesting figures are given by Superintendent Charles Selden, of the Baltimore & Ohio Railway Telegraph, which give a good idea of the immense importance of the telegraph to the operation of the railway. The average number of messages handled every day on the Baltimore & Ohio system, exclusive of train orders, is 53,000. The Baltimore & Ohio Company has 22,252 miles of telegraph wire, of which the company uses 7,240 miles for its own business, while the balance is leased to the Western Union Telegraph Company. There are 384 telegraph offices on the line, of which 234 are reporting Western Union offices. In the telegraph department of the railroad company 750 men are employed, exclusive of linemen, and the service of the company's plant is considerably augmented by the use of multiplex systems of telegraph.

Electric Elevators.—VI.

ELEKTRON ELECTRIC ELEVATORS.

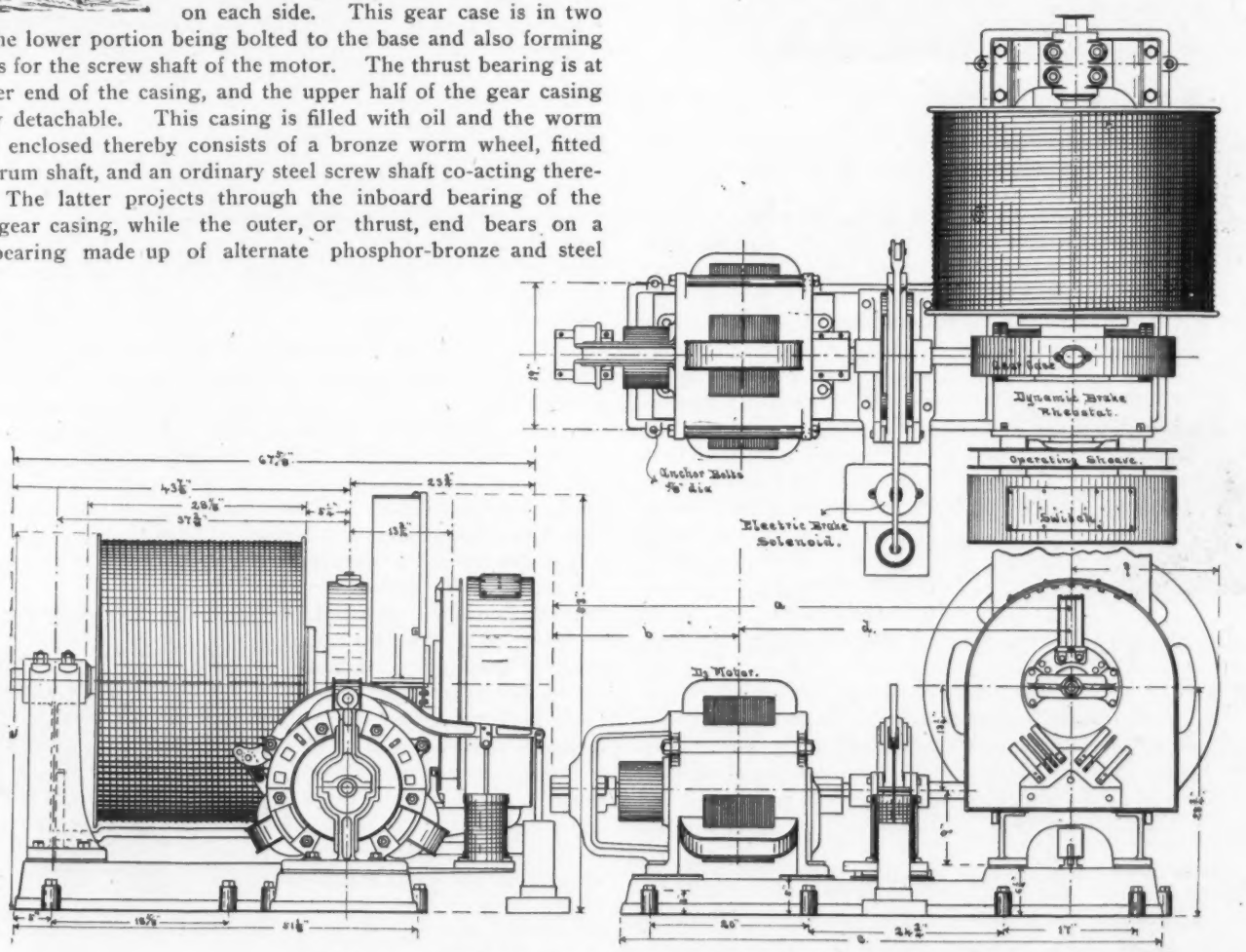


WHILE various types of electric motors are specially manufactured for elevator work, very few dynamo and motor manufacturers build complete electric elevator machinery. The Elektron Manufacturing Company, appreciating the possibilities of electric elevators, was one of the earliest electrical manufacturers to take up this line of work, and has developed a line of electric elevators which it manufactures complete.

The standard Elektron elevator, for either freight or passenger service, is of the single worm gear drum-winding type. These machines are built for speeds up to 300 feet per minute and rises to about 150 feet. In general construction this elevator machine consists of an L-shaped base plate, upon which is mounted at the wide end a grooved winding drum supported on a heavy shaft, one end of which runs in the bearing standard, while the other projects through the gear casing, having bearings on each side. This gear case is in two parts, the lower portion being bolted to the base and also forming bearings for the screw shaft of the motor. The thrust bearing is at the outer end of the casing, and the upper half of the gear casing is easily detachable. This casing is filled with oil and the worm gearing enclosed thereby consists of a bronze worm wheel, fitted to the drum shaft, and an ordinary steel screw shaft co-acting therewith. The latter projects through the inboard bearing of the lower gear casing, while the outer, or thrust, end bears on a thrust bearing made up of alternate phosphor-bronze and steel discs. At the narrow end of the base a Perret multipolar motor is bolted. These motors embody some peculiar features and are generally well known. The field is made up of a number of separate magnets, each magnetic couple being complete in itself, and having an independent circuit, composed of iron laminations. Usually these machines have six poles, inwardly directed to a slotted drum armature, current being taken therefrom by a single pair of brushes. They are compound wound and operate at a moderately slow speed.

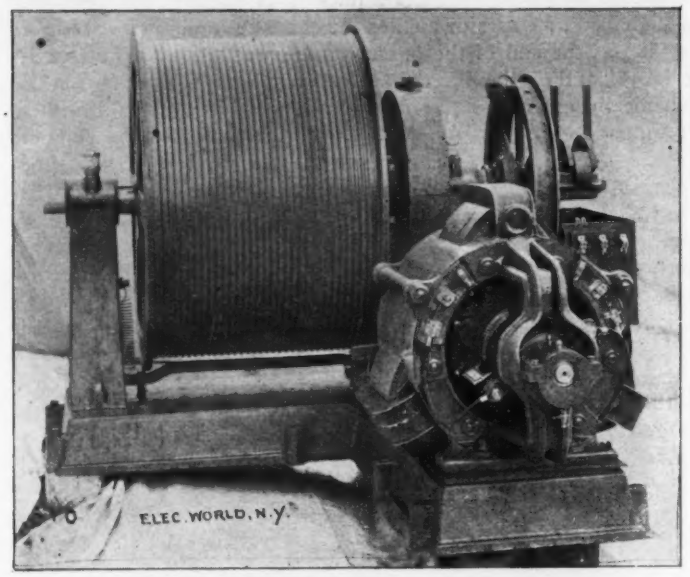
A flanged brake pulley coupling connects the motor shaft to the gearing screw shaft. The brake shoes are arranged to clutch this pulley. For ordinary service a single mechanical brake is used, but for passenger service an auxiliary electrical brake is added. The braking mechanism consists of two curved arms which encircle the pulley and are pivoted to an upright on one side. Each of these bent arms or levers is fitted on its inner side with a concave wooden brake shoe which comes into contact with the pulley. The other ends are both pivoted to a long curved operating lever, so that one of the pivots becomes a fulcrum to the long lever which, when operated, releases or applies the shoes to the brake. A weight or spring at the end of the operating lever counteracts the releasing movement of the long lever. This braking mechanism is mechanically operated by another bell crank lever at right angles thereto, and is in turn operated by a cam on the operating shipper sheave. Where an auxiliary electric brake is used the brake shoe mechanism is duplicated, and the operating lever at the long end is directly connected to the armature core of an electromagnet, whose action releases the brake shoes. It may also be stated that for high-class passenger service dynamic braking is used, by operating the motor as a dynamo on short-circuit. This method is used in connection with the electric brake only, the mechanically operated braking mechanism being discarded. The connections and arrangements of these electric braking devices will be discussed later.

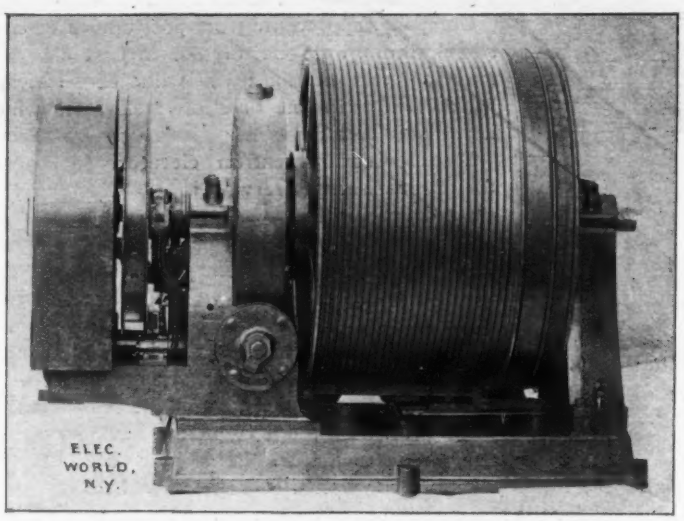
Fitted to the end of the main drum shaft which projects through the gear casing is the operating or shipper sheave, which is a grooved wheel fitted with a U-shaped casting on one side and loosely mounted on the main drum shaft. The end of the main drum shaft, over which the operating sheave is mounted, is threaded. Fitted to the U-shaped casting are two switch blades, and the operation of the sheave in either direction throws the switch blades into contact with the terminal clips fastened to the insulated support below. On the inner side of the sheave is a cam which co-acts with the brake levers when the wheel is turned, applying or releasing the brake shoes. It is to be noted that the control of these machines from the car is entirely mechanical by means of a positive rope mechanism. Ordinarily the rope, which is fastened



DETAILS OF ASSEMBLED DRUM-WINDING ELECTRIC ELEVATOR.

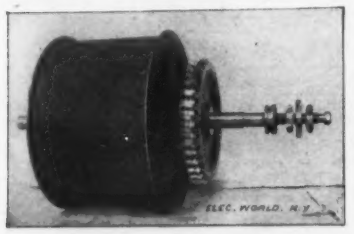
to the shipper sheave, making several convolutions around it, is directly operated, but for passenger service, a special wheel operating device in the car has been devised, the operation of which will be readily understood from the illustration. Closing the switch blades on one side or the other of the normal vertical position into contact with the terminal clips on either side suitably connects the motor to the line and also sets into action the automatic-starting rheostat devices. The motor operates in both hoisting and lowering, and it is only necessary to operate the main switch to start the motor in either direction. When lowering, the passenger elevators return much current to the line.



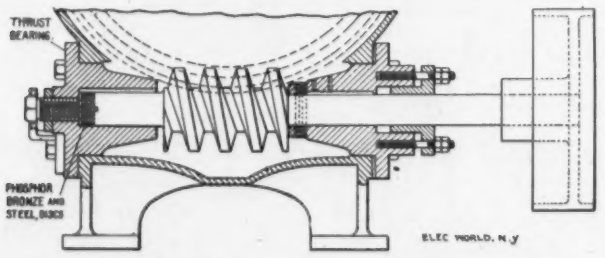


Standard Type Drum Winding Electric Elevator.

A description of the various safeties is proper here. As the operation of the shipper sheave controls the motor and brake, these devices are arranged to operate this wheel automatically in the same manner as if it were operated manually by the shipper rope. The upper and lower limits are of the form very frequently adopted in electric drum winding machines, consisting of a guided nut, to which a straight-line movement is imparted by a rotating screw shaft. When the nut has reached a certain limit of motion in either direction it strikes a stop block, and as it can go no further it then gives the operating devices or switch a rotary movement with the shaft. In this particular machine, the nut moves on the threaded portion of the main shaft previously mentioned. It is fitted with diametrically opposite lugs slotted at each outer end, and sliding in guides on the inside of the U-shaped casting on the shipper sheave. Fastened to the screw portion of the shaft are two stop clamps, the distance between which can be adjusted, and between which the nut moves in a straight line, owing to the fact that the tension on the loose shipper sheave keeps it stationary. When, however, the nut strikes either of the stop clamps it can move no further, and then rotates with the main shaft, whose movement in either direction, transmitted to the sheave, turns it back to its normal open position, opening the switch and applying the brake mechanism through the cam. The slack cable stop consists of a pivoted bar hung immediately beneath the winding drum on a line with its axis. By an arrangement of levers this bar operates a movable toothed clutch collar keyed to the main shaft. The latter when moved toward the sheave, meshes into a corresponding collar fitted thereto, and thus turns the shipper wheel as previously described. A loosening of the cable causing it to drop on the bar, counteracts the action of a spring which normally keeps the key clutch collar free. Where dynamic stopping devices are used the operation of the sheave by these safeties automatically operates the short-circuiting rheostat, which is fitted to the side of the gear casing, the contact arm of which being operated by a cam on the shipper sheave. It may also be noted at this point that these machines are suitably counter-weighted for a certain percentage of load by separate counterweight ropes, oppositely wound on the drum to the hoisting ropes, and also by additional counterweights from the car.

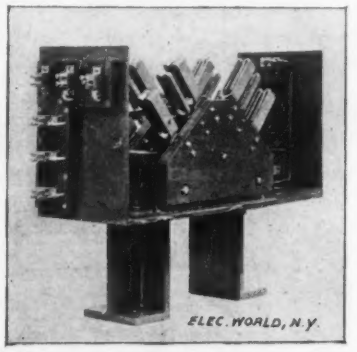


Winding Drum and Shaft.



Worm-Gear, Bearings and Brake Pulley.

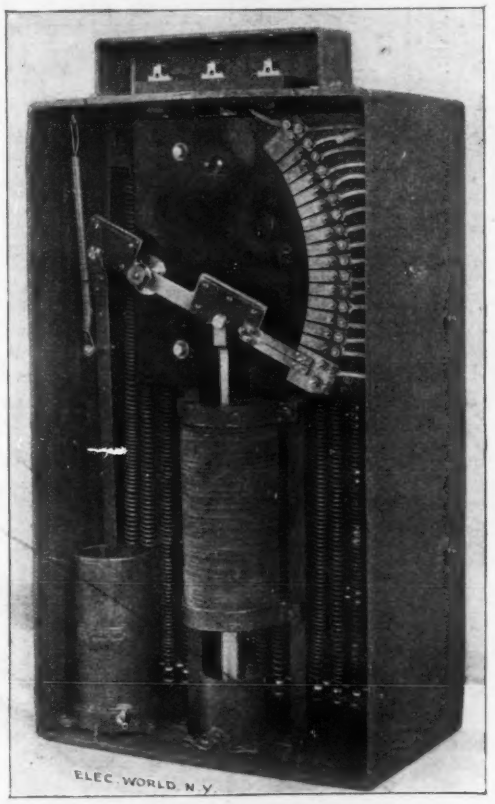
The controlling apparatus of this machine is practically of the automatic electromagnetic starter type with a mechanically operated main switch. The main starting switch of a machine is entirely covered by a detachable casing. The two switch blades on the wheel are each mounted on slate blocks and have spring brake clips on both sides. The armature, line, and field wires, and in some cases the terminal from the auxiliary electric brake and automatic rheostat solenoid, are brought to the terminal clips in the switch box immediately below the U-shaped casting on the sheave. These clip contacts are arranged double-pole and are in duplicate, one on each side of the centre. An inspection of the illustration will show that the switch blades move through a very large arc from their normal open position before making contact with the terminal clips on either side.



Switch Blades.

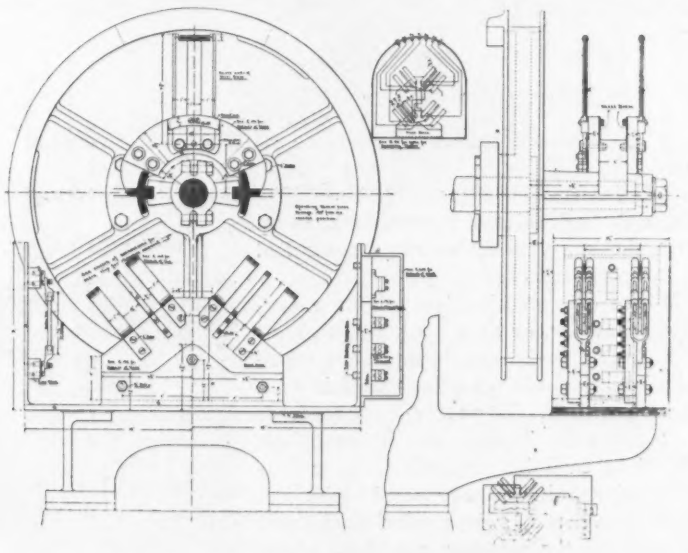
An automatic starting rheostat which is entirely separate from the elevator machine controls the starting of the motor. It is suitably fitted in an iron box and can be placed anywhere adjacent to the motor, being connected thereto by the necessary wire. It consists of a coiled German silver open-air wire rheostat, the contacts being mounted in an arc on an insulating base. Over these contacts a pivoted arm moves which is connected to the core of a solenoid coil, and is operated thereby against the tension of a spring. The rate of movement of the contact arm is controlled by a dash pot and can be adjusted. The connections of the motor automatic starter and main switch are shown in the diagram, which is quite simple and needs no further explanation. Where an auxiliary brake is used it is connected in shunt with the solenoid and both controlled by an extra single clip on each side of the main switch; otherwise, the solenoid is controlled from the field clips. To

operate the elevator in either direction, the shipper sheave is moved so as to make contact with the terminal clips on either side, and at the same time release the brake. The action of the solenoid causes the core to gradually raise the contact arm, cutting out the armature resistance and accelerating the speed of the motor. In reversing the blades the sheave must be moved through an arc of 270 degrees before coming in contact with the clips on the other side, which are connected to give rotation of the motor in the



AUTOMATIC RHEOSTAT.

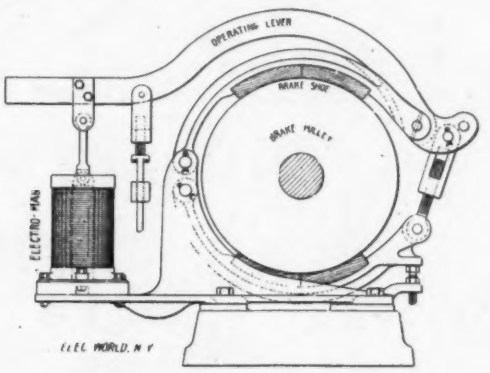
opposite direction. This permits the resistance arm to return to its normal position, and the motor is, therefore, always started with the resistance in circuit. A suitable adjustment between the starting rope movement and the time of operation of the solenoid is necessary. Sparking and flashing at the switch are also greatly reduced by the long break and the snap clips on the switch blade. With this method of control only one speed is obtainable,



SHIPPER SHEAVE SWITCH AND CONNECTIONS.

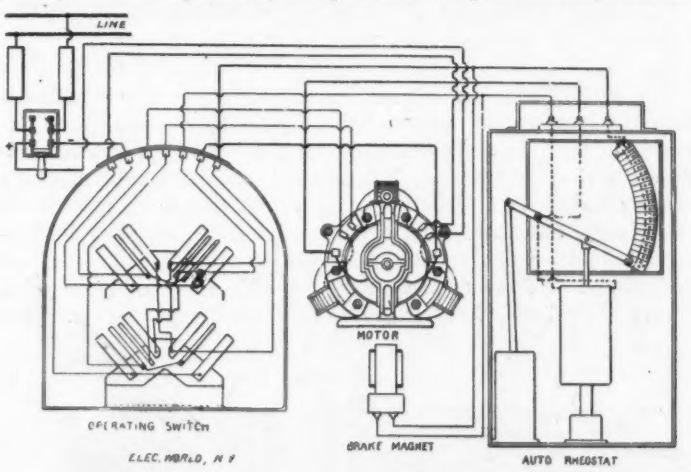
and the starting of the motor further than the operation of the switch, and its rate of acceleration, is taken entirely out of the car operator's control.

For high-class passenger service, the motor is controlled by a method somewhat different from that shown in this diagram of connections. In such instances the dynamic braking controller illustrated is used. The motor is always connected on short circuit, even when inoperative. An electrically operated brake is used to hold the drum only, but not for the stopping, and is applied only when the current is broken at the main switch. In stopping the field remains excited, while the armature terminals are short-circuited through the resistance, which is gradually increased until the main circuit is broken, and the electric brake applied. The stopping resistance operated by the shipper sheave has been previously described and illustrated. A large double gear Elektron elevator is shown. This machine is fitted with a slow-speed gear similar to the back gear of a lathe, which can be thrown into action when it is desired to lift a heavy load at a correspondingly slower speed than the normal. The efficiency of the gear is said to be over 75 per cent.



DETAILS OF ELECTRIC BRAKE.

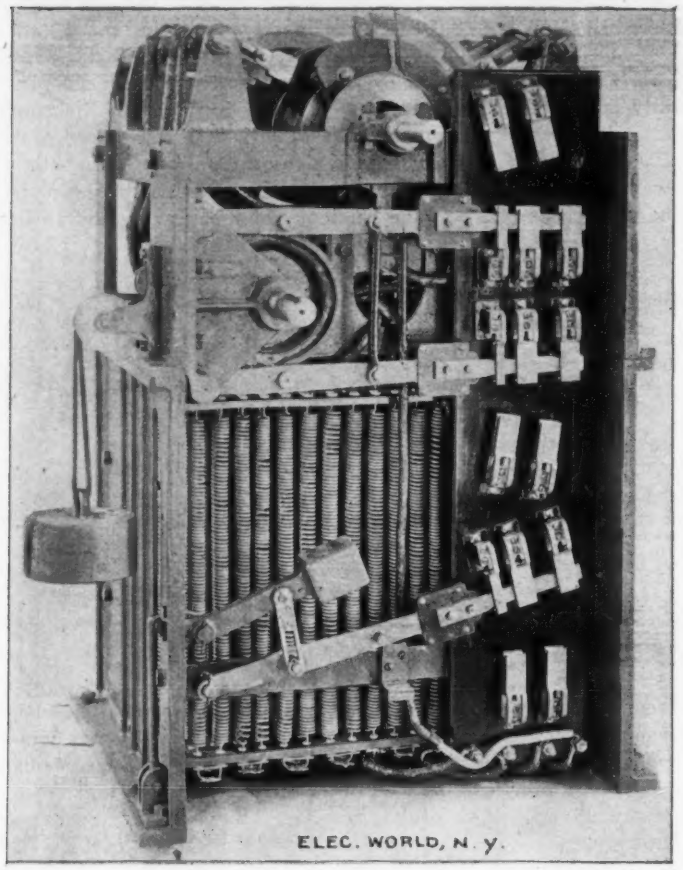
Aside from the drum-winding machines above described, a small grip sheave electric elevator for light duty is also built by this company. This machine is used particularly for residences, book hoist, dumb-waiter, carriage, or other similar elevators and apparatus, usually at slow speed duty service. The machine is extremely unique in its operation, compact and simple. It consists of



CONNECTIONS OF DRUM WINDING ELECTRIC ELEVATOR.

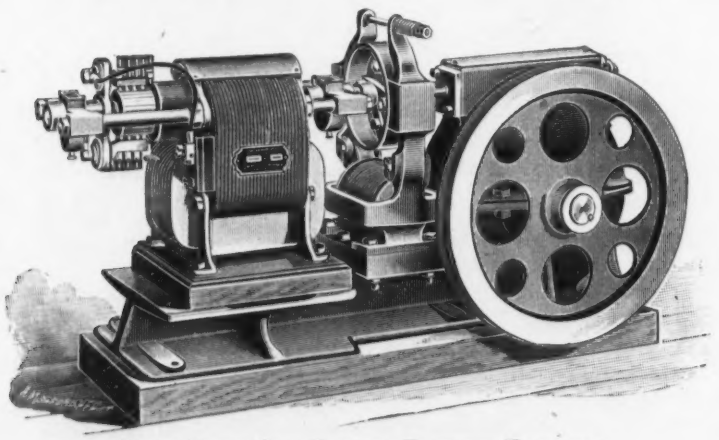
an oblong base upon which is mounted at one end a small bipolar Perret motor. The armature shaft of this motor is directly coupled by means of a brake pulley coupling to a screw shaft forming part of the worm gearing mounted on the other end of the base of the machine. Meshing into the driving screw shaft is a bronze worm wheel, and the entire gearing is enclosed in an oil-filled casing. The shaft of the worm wheel projects at one side of the casing and fitted thereto is a grip hoisting sheave, over which the hoisting cable passes. This feature of the machine is particularly notable, as it is rather a distinct departure from ordinary practice. The hoisting cable is not wound on a drum as ordinarily, but passes from the top of the car to the grip sheave, around which it makes a half turn, dropping down on the other side to a counterweight. The grooved grip sheave is arranged so as to give a gripping or biting action on the hoisting cable. By eliminating the ordinary drum, the machine is made particularly compact, and for low-speed service it is claimed that absolutely no slipping occurs with the grip that is possible between the grip sheave and the cable. Between the motor and the gear casing is an electromagnetic brake, consisting of an electromagnet surrounded by a casting to which

is pivoted at each end a lever, the inner side of which has a brake shoe coming in contact with the surface of the brake pulley. The levers are normally applied to the pulley by a spring, whose action is counteracted by the magnet when energized.



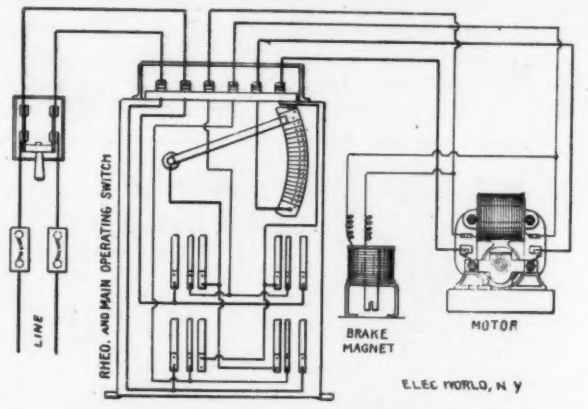
Front and Rear of Dynamo.

The control and operation of this type of elevator machine is either by means of an ordinary hand rope or by a special push-button system. The controller used for the hand rope operation is shown in the illustration. It consists of an iron box enclosing a suitable switch and rheostat, which are operated by mechanical means only. The double pole switch blades are mounted on insulating blocks fitted to a spindle which projects through the iron box casing, and is fitted at the outer end with a grooved operating sheave around which passes the shipper rope from the car. On



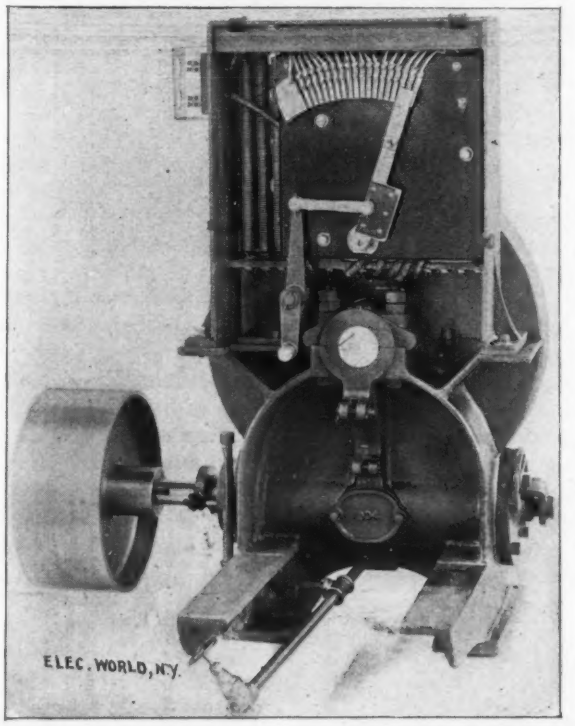
Light Duty Grip Sheave Electric Elevator.

each side of the centrally located spindle are suitable main switch clips connected with the line, armature, and field wires. The turning of the operating sheave wheel causes the spindle to be rotated in a corresponding direction, moving the switch blades from their normal central vertical position into contact with the contact clips on either side, giving the desired rotation to the motor. Immediately above the switch is a rheostat whose contacts are brought out on an insulating base in front, and over which moves a pivoted contact arm. This contact arm is connected to a vertical rod which is actuated by a second pivoted lever receiving movement from a cam on the switch spindle. Normally, when the switch blades are in the open position, the cam on the spindle raises the



Grip Sheave Electric Elevator Connections, Hand Rope Control.

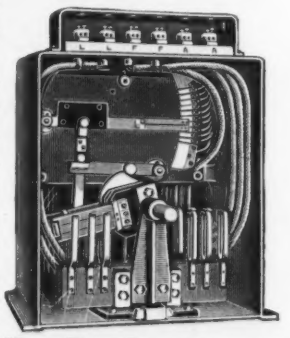
last lever so that the main resistance contact arm is up with the resistance all in circuit. As the spindle is turned, the cam is so arranged as to allow the arm to drop against the action of a dash pot. The speed of cutting out of the resistance, therefore, can be graduated. It will be seen that the motor is shunt wound, and



Sheave-Operated Dynamic Short-Circuiting Switch.

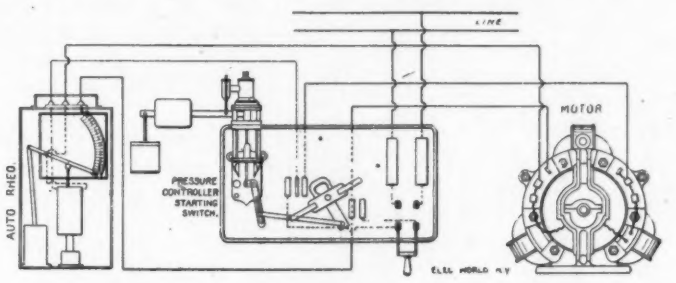
the brake solenoid or magnet is in shunt with the shunt field, which is controlled at the main switch.

Where this machine is used for a residence elevator, or as a book hoist, or for any similar purpose, a push-button method of operation is sometimes used in connection with it. In one of these methods a three-push button, as illustrated, is placed at each landing, all of these buttons being suitably connected with an electro-magnetic switch device located adjacent to the elevator machine. This electro-magnetic switching device consists of practically the same elements as the last described switch, excepting that it is operated by means of electromagnets instead of the hand rope. An automatic rheostat, such as is used with the other forms of electric elevators, is also used for starting the motor, instead of the



Hand Rope Controller for Grip Sheave Elevator.

mechanically controlled rheostat. As will be noticed the controlling buttons are marked "up," "down" and "stop." For dumb-waiter and book hoisting and similar purposes, the car is not provided with any operating device. The operation of any of the floor pushes for up or down operation of the motor, actuates one of the switch-operating solenoids or magnets, throwing in the switch on that particular side, connecting the motor and automatic starting rheostat to give the desired rotation, and cutting out the resistance. The pushing of the other button for the opposite movement of the elevator car energizes the other magnet and throws the switch on the other side. The operation of the stop button brings the switch back to its normal position. Another push button control consists of separate single buttons located on each floor landing and a compound button placed in the elevator car. This method is principally used for residence elevators. The buttons on the landings and those in the car are connected with a similar electro-magnetic starting switch mechanism as above described. The car-controlling button is simply an aggregation of contacts corresponding and similar in connection to those provided at the different floor landings. At each landing a switching device is placed which is operated by the movement of the car in the shaft. When any of the floor buttons are pushed, the car is brought to that particular floor, and stops itself by the operation of the switch which controls the respective circuit including the button which has been operated at the landing or in the car.



PUMP MOTOR AUTOMATIC CONTROL.

The Elektron Company also manufactures various special motor-controlling arrangements to be used with motors for elevator purposes other than direct-connected machinery. One of these arrangements is shown in the diagram. In this case the motor operates a pump, supplying the cylinders of an ordinary hydraulic elevator. The electric motor is controlled by a hydraulic pressure valve of peculiar construction, which is connected with the main switch. When the pressure in the tank or in the cylinders goes above or below the normal, the valve automatically throws the switch into or out of connection, thereby starting or stopping the motor. In connection with this switch an automatic starting rheostat is used.

The Synchronograph.

At the last meeting of the American Institute of Electrical Engineers, Mr. Albert C. Crehore and Lieut. George O. Squier presented a paper entitled "The Synchronograph; A New Method of Rapidly Transmitting Intelligence by the Alternating Current."

An abstract of the paper appears below:

In a general view of the technical history of the art of telegraphy, statistics show that at the present time, more than fifty years since the introduction of the telegraph, nine-tenths of the telegraph business of the world is transmitted by hand in substantially the same manner as then. From an electrical point of view one naturally asks why it is that during this period, which represents more electrical progress than all time previous, the rapid transmission of intelligence has not made more advance.

It is to experiments upon a new electrical system of rapid intelligence transmission and its possibilities, that your attention and consideration are invited. It is not intended to enter into a discussion here of the physical causes which have limited the speed and efficiency of the telegraph, but to acknowledge the great work of Wheatstone, Hughes, Edison, Delany and others, who have brought rapid telegraphy to its present state of efficiency, and proceed to an explanation of the principles involved in the new system, and an account of the experiments already carried out in developing it. These experiments were conducted at the Electrical Laboratory of the United States Artillery School, Fort Monroe, Va., where the land telegraph and telephone lines were available for the actual trials described.

The subject of transmitters cannot be easily treated apart from that of their receivers. The qualities of receiving instruments include two principal elements. All require energy for their operation, and most of them have inertia in the moving parts. A great advance is made by the design of a receiver which dispenses with this inertia, and this has been accomplished by electrolysis in certain chemical receivers used in the instruments described. The inherent distinction between telephony and telegraphy is mainly that the telephone utilizes both the frequency of the waves sent to it and their form, while the telegraph relies entirely upon the number, duration, and order of arrangement of these waves without reference to their form. There are reasons why any system using waves of different duration is not as simple as one which uses waves of equal duration, when any arangement of make and break transmitter and a constant source of E. M. F. are employed. The chief of these are the electrical properties of the lines carrying the current. Difficulties which are not apparent at the ordinary speeds of hand telegraphy become of great importance when rapid machine transmission is attempted. The difficulty is noticeable both in the making and breaking of the circuit. Long lines having definite capacity and inductance require time to be charged and discharged, and vary the form of the waves sent over them by reason of the actions of both these elements. Their capacity, especially, produces what is known as "tailing" in telegraphy, which means that a signal is so drawn out at the receiving end as to interfere with the following signal. By use of equal waves, preferably of a sinusoidal form, the effect of tailing is reduced.

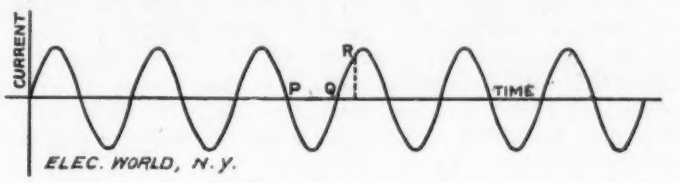


FIG. 1.

The alternating current is at present successfully employed for transmitting considerable amounts of power over long distances, and the whole system is periodically subjected to a regular and uniform succession of waves rising gradually from zero to a maximum, and then gradually decreasing, reversing and increasing to a negative maximum. Recognizing these facts, it seems probable that it would constitute a good means for the rapid transmission of intelligence, if the characters of a telegraphic code could be impressed upon such a current without seriously affecting its regular operation.

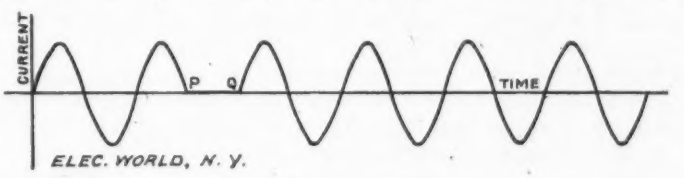


FIG. 2.

Let the sine curve (Fig. 1) represent a regular succession of simple harmonic current waves, given to the line by an alternating current generator. If the current passes through a key which may be opened or closed at pleasure, then, provided this key is open at a time corresponding to the point *P* of the wave upon the horizontal axis, it is known that the current which was zero at the instant the key was opened will remain zero thereafter, in circuits which have resistance and inductance alone. If the key could be closed exactly at a time corresponding to the point *Q* on the curve, also upon the axis, the current will resume its flow undisturbed, according to the sine curve. The true current obtained by opening the key at *P* and closing it at *Q* is shown in Fig. 2, where the current remains zero between these two points. If the key had been closed at any other point than *Q* the current would not have resumed its flow according to the simple sine wave, but it can be shown that it would give a succession of waves alternately smaller and larger

than the normal sine wave, these differences gradually dying out until the current became coincident with the sine wave. In like manner if the current is opened at any other point than at one of the zero instants when the curve is crossing the axis, a spark may be observed at the break, and time will be required for the current in the line to fall to zero. The advantages obtained by operating thus upon an alternating current are evident. Considerable amounts of power may be transmitted over lines worked in this way with no spark at the contact breaker, thus making it possible to use comparatively large E. M. F. from currents on the line. It is also possible by this means to utilize waves of high frequency upon the line, the limits of the generating machinery probably being much higher than the transmission capacity of the line. If a receiver is used which reproduces an exact trace of the actual wave sent over the line by interrupting the sine curve for a half wave length to correspond with a dot, and a whole wave length to correspond with a dash of the ordinary Morse or Continental code, intelligible signals might be sent. The space between the parts of a letter might be indicated by tracings of one-half wave length and the space between letters by the tracing of a whole wave length. The space between words and sentences might be made comparatively longer. A consideration of the time

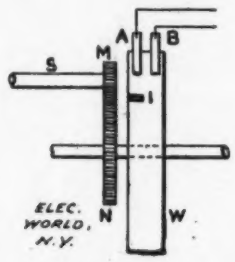


Fig. 3.

required to send the word "ten" by the above plan shows that it corresponds to the time of eleven half waves of current. With the ordinary method, allowing a frequency of 140 complete waves per second, the word "ten" can be sent in 0.1394 second, or by allowing three additional half waves for the space between the words, the word "ten" would be sent just 1,200 times in one minute. There is no difficulty in using over some lines a frequency four times as great as that ordinarily used, namely as high as 560 or even 600 periods per second. This would correspond to speeds of 4800 and 5143 times sending the word "ten" per minute. In each instance the limit can only be determined by the constants of the particular line in use.

The method of manipulating the key to make and break the current at the instants of zero current has not yet been shown, but it is evident that this can be most successfully accomplished at the generator itself or by any motor mechanism running synchronously therewith.

It will be sufficient for purposes of illustration to show by a special example how any single half-wave may thus be controlled at the generator; for obviously any word or sentence may be formed by a repetition of this operation.

In Fig. 3, *S* represents the shaft of an ordinary 10-pole alternating current generator which drives through the gears *M* and *N*, the wheel *W*. The circumference of this wheel is one continuous conductor presenting a smooth surface for brushes to bear upon. If the periphery of the wheel is divided, for example, into forty equal parts, and it is geared to run at one-fourth the speed of the armature, each division thereof coresponds to one semicycle of the electromotive force produced by the generator. Upon the wheel *W* bear two brushes *A* and *B*, carried by a brush holder which is capable of adjustment. These two brushes are connected in series with the line, so that the current which passes in at one brush is conducted through the wheel to the other brush and thence to the line. The current used may be obtained from the generator, the shaft of which is represented at *S*, either before or after it has passed through any number of transformers, since it is the frequency alone with which we are concerned.

The line current is brought to the wheel *W* to be synchronously operated upon. If both brushes remain continually in contact with the wheel, the current transmitted would have the regular sine form represented in Fig. 1, and for each revolution of the wheel there would be forty semi-waves or twenty complete waves transmitted. If one-fortieth of the circumference of the wheel is covered by paper or other insulating material as indicated at *I*, Fig. 5, and the brush *A* adjusted to ride onto and off from this insulation just as the current is changing from one semicycle to the next, that is, changing sign, while the brush *B* is in continuous engagement with the wheel, the semicycle represented by the section covered will be suppressed, and without any sparking, even if the potential used is high. In practice the brush *A* is easily adjusted to this point by moving it slightly backward or forward around the circumference of the wheel until the sparking ceases. This adjustment once made, the brush is fixed in position and so remains. In each succeeding revolution of the wheel, this cycle of operations is exactly repeated, and the current sent over the line would resemble that shown in Fig. 2, having every fortieth semicycle omitted. It is only necessary to cover other similar sections of the circumference of the wheel in a predetermined order according to a code, to transmit intelligence over the line. The above illustration of the operation of a transmitter on this principle is given for simplicity only, and is evidently far from a practical form of transmitter.

The wheel *W* in the above example may have different speeds with respect to the generator shaft, the essential condition being that its circumference shall contain some integer number of a unit, which is the arc upon the circumference of the wheel if geared to the armature, that a point fixed with respect to the field would describe upon it during one semi-period of the current. This wheel therefore might be connected to any shaft which runs in synchronism with that of the generator, as, for instance, that of a synchronous motor if the power were obtained from a distance.

Instead of using insulating papers situated upon a single circumference of the wheel, two or more similar lines may be used either upon different circumferences of the same wheel or upon different wheels, and separate brushes ride upon the different circumferences. The same frequencies of current may be employed to operate all lines of brushes, or currents having different frequencies may be employed upon the separate circuits, all of which use the same line of transmission. These arrangements make it possible either to send different messages simultaneously over the same line employing a single cycle as the unit, or to send a message employing different frequencies to represent the different characters of a code or many combinations of these.

The employment of alternating waves of different frequencies upon the same line by the method shown does not have the same objections which exist when a constant electromotive force is used. Since the circuit is always interrupted when the current is zero, the frequency employed is a matter of indifference, as the lines are in the same condition whether a long or short wave length is used.

In this paper the term "receiver" is understood to mean that mechanism which uses energy transmitted over the electric circuit, and transforms it so as to make a permanent record, which may be translated into intelligence. The term is restricted to mean instruments which make a permanent record, since this is a necessary condition for the rapid transmission of intelligence. There are several methods of classifying receivers. In deciding upon their relative merits from the point of view of rapidity, the cost of power offers no reason why considerable amounts should not be transmitted over certain land lines for telegraphic purposes. When a receiver is used which has considerable inertia in its moving parts, it does not necessarily follow that it will be rapid in its action, even though considerable energy reaches it. As types of receivers having no inertia may be mentioned the various forms of chemical receivers acting by electrolysis. This type possesses many advantages; chief among them its simplicity and the fact that much of the energy received is brought directly to bear upon making the record. In the experiments described here a new type of receiver, having no inertia, was utilized. This instrument has previously demonstrated its value as a chronograph for the measurement of minute intervals of time. Its application as a practical telegraph receiver is not at present advocated, yet the realization of a massless receiver upon different lines merits description. The instrument consist of an electric arc lamp sending a beam of light through a Nichol prism, which plane polarizes it. This beam is then directed through a glass tube, having plane glass ends, filled with bisulphide of carbon and surrounded by a coil of wire, so that

the magnetic lines due to the coil when energized are parallel to the beam of polarized light. Beyond the tube a second Nichol prism, rotated 90 degrees from the first, receives the beam. Behind this is a steel case adapted to receive a photographic plate and to be rotated at high speeds by an electric motor. The beam coming through the second Nicol prism is condensed and focused upon the revolving plate through a lens system and a radial slit. Under ordinary conditions no light can pass through the apparatus, but when an electric current passes in the coil of wire surrounding the tube of carbon bisulphide, a rotation of the plane of polarization of the beam is effected, and the light is thus rendered able to traverse the second Nichol prism and fall upon the photographic plate. An alternating current sent around a coil in this way gives rise to a series of luminous impulses which trace upon the sensitive plate a line of more or less extended dots, according to the speed of rotation. The arrangement, of course, possesses no inertia, and it is practically instantaneous in its operation. In these experiments the operation upon alternating currents was accomplished by means of a prepared perforated paper tape which was caused to move by the generator itself. A metallic wheel was geared to the shaft of the generator, so that its ratio of velocity of revolution was accurately known. In this way the length of arc of this wheel traversed during one-half wave period of the current could be accurately calculated, and the paper tape perforated accordingly. For simplicity, this tape was made in the form of an endless belt, and, running over another small wheel, was drawn between two brushes which made contact between its perforations, or were separated by the portions left unperforated. The generator used in the earlier experiments was a Fort Wayne 10-pole alternator, having a terminal potential of 1,000 volts. This was transformed to about 300 volts, as that potential was more convenient to handle and was sufficiently high for the purpose. The revolving wheel was driven through one revolution by 18.4 revolutions of the armature, thus making one-one-hundred-and-eighty-fourth of the circumference corespond to one semicycle of the current. It was found that very little adjustment was necessary to get the whole of this apparatus in synchronous operation, this point being easily determined by the disappearance of the spark between the brushes. To test the speed of transmission, this alternator was driven occasionally as high as 2400 revolutions per minute, although it was designed to run at only 1600. A special high-frequency alternator was also utilized for testing the system at still higher speeds of transmission. The highest speed utilized corresponded to 65,400 semi-cycles per minute, or a speed of between 3000 and 4000 words in that period. No difficulty was experienced in sending and recording messages at this rapid rate. After discussion of the principles of the chemical receiver and of the influence of distributed capacity and inductance on long lines, a description was given of some experiments made over the land telegraph and telephone lines upon the military reservations at Fort Monroe, Va. Here messages were sent without difficulty through thirteen miles of iron wire, having a resistance of 320 ohms, with other resistance included in the line bringing the total to 1500 ohms.

When the extent of the transmission of intelligence at the present time is considered, and the direct influence which this service has upon the development of the world's progress, any proposition which promises to increase its efficiency should be received with consideration.

To better comprehend the volume of this service it is of interest to observe the statistics on the subject.

It is noticed in general that there is an increase in all departments of the intelligence transmission service from the earliest dates. The number of pieces of mail sent during 1896 was 5,693,000,000, which is the greatest amount ever sent in a single year. The greatest number of telephone messages on record for a single year is 757,000,000, in 1895. The largest number of telegraph messages was sent in 1893 and amounted to 66,000,000. Thus the greatest number of telegraph messages as compared with telephone messages is in the ratio of 1 to 11½. The greatest number of pieces of mail is in the ratio of 86 to 1 as compared with telegraph messages, or in the ratio of 7½ to 1 as compared with telephone messages. It is also seen that the cost of the mail service of the United States in 1896 was $90,626,000, or about $1.25 per capita. The greatest receipts for any year of the American Bell Telephone Company were in 1895, $16,400,000, about 25 cents per capita, while the greatest receipts of the Western Union Telegraph Company were in 1893, $24,978,000, about 35 cents per capita.

It appears therefore that the people of the United States pay for a telegraph service of about one eighty-sixth the amount, about one-fourth of that paid for the entire mail service of the United States. It also costs one and a half times as much for telegraph service as for the telephone service, although the number of telephone messages is about eleven and a half times as great.

A conclusion to be drawn from the above general data seems to be that the people are willing to pay more in proportion for a kind of service like that of the telegraph than any other. From the point of serving the people, as well as from a business standpoint, it appears that improvement in this class of intelligence transmission is at present much to be desired. The present state of the art of telegraphy points to improvements along the line of automatic machine transmission.

It is of interest to inquire what effects a system of telegraphy capable of sending continuously 3,000 words a minute would have on the existing methods. To take a single example of the business between New York and Chicago, where about 40,000 letters are carried daily, it would require but two lines in continuous operation to handle the entire business. At present it takes three days to receive a business reply between New York and Chicago. This transmission by machine telegraphy could be accomplished easily the same day. It is thought that an effect of this kind would be to increase business transactions to such an extent that the total volume of intelligence transmitted would be augmented, rather than to diminish the business now done by existing methods.

The class of business which such a system would probably at first obtain would be the less urgent telegraph business of greater volume, such as the Associated Press dispatches and newspaper press reports. Among the possibilities is the simultaneous publication of the same newspaper in different parts of the country. For example, in an edition of a daily paper having twelve pages and eight columns per page, making ninety-six columns in all, there are less than 185,000 words. At the rate of 3000 words per minute it would only require about an hour to transmit the entire contents of the paper. This calculation furthermore assumes that the whole paper is uniformly printed in fine type. It would require a single operator, working by hand and averaging twenty words per minute, over six days of twenty-four hours each to send this amount.

The system proposed in this paper is especially adapted to meet the demands of this class of business; for the great flexibility of the alternating current as employed permits if necessary considerable amounts of power to be transmitted over the line, which may be used for making simultaneous manifold copies of the same dispatches in each of widely separated cities. In this manner each of the several newspaper company subscribers in each city receives the identical service with the minimum delay, since each copy received is an original. Each additional subscriber to this service represents no appreciable expense to the company, since it requires but another receiving needle. Furthermore, the use of the alternating currents permits the line to be used quadruplex at very rapid speeds, that is, four entirely different dispatches may be sent over one wire at the same time, two in each direction, and any number of copies of one or all the dispatches may be received independently at the same time.

In addition to the above it is practicable to employ the line for a system of the ordinary quadruplex telegraphy at the same time. In experiments in the laboratory, instructions were given to the operator of the Morse instrument to observe when messages were being sent by the alternating current, and no effect was detected.

The objection may be urged that it is already difficult to handle the business at the present rate of operation of the Wheatstone system, and if the instruments worked faster it could not be handled. This objection is undoubtedly a real one in some cases, and it is partly this fact which indicates that it may be easier to inaugurate new methods than to attempt to adapt the new rapid transmitters to the present methods.

A telegraph office of the future will probably present a different appearance from that which may now be seen in any of the large cities. At present in operating the Wheatstone system in this country, sending to long distances at the rate of 150 to 200 words per minute, both those who prepare the sending tape and those who translate the receiving tape are employees of the tele-

graph company and are near the sending and receiving instruments. If it requires about ten men to prepare tape, and as many more to translate it for a single instrument operating at 150 words per minute, it will require twenty times this working force for one of the rapid machine transmitters. Evidently changes would be required in the present methods to handle this business.

It is thought that a telegraph company of the future will fulfill a somewhat different function from the present ones. The company will own its wires and rights of way as now, but the tendency of the offices proper will be to transmit and receive letters already prepared rather than to undertake the preparation of the letters as well. The income of the company will be derived from the rent of its lines at a fixed price per minute, or a fixed price per hundred words. The service of the telegraph office then becomes like that of the post office, its duty being to receive and deliver letters already prepared, as the post office does. The difference between the two offices is in the manner in which this is accomplished. The telegraph office becomes a post office which employs an electric current in a copper wire to carry its letters instead of a railroad train. The advantages in point of speed of delivering letters by the former method are apparent. Instead of requiring twenty-four hours to deliver letters between New York and Chicago, it will require but a few hours at most, and make it possible to receive a reply the same day. It is probable that such a system would take more business from the present postal system than any other; for when telegraph letters can be sent at reasonable rates comparable with postage, in a few hours instead of many days, a certain amount of present post office business will be diverted. More than this, when business can be done with greater facility than at present the total volume of business will undoubtedly be increased, because transactions may take place in a day which formerly required a week.

It would be to the interest of such a company to seek that class of less urgent business now done by correspondence, rather than the class handled by the present telegraph companies, where the highest speed of delivery is expected. If one trunk line becomes established between large business centers, it will draw business from a surrounding area. For instance, if a line were established between New York and Chicago, and a person in Albany desired to communicate with Chicago or points beyond, it would be quicker to send the letter to New York for transmission over the trunk line to Chicago, and then by rail to its destination, than to send directly by rail from Albany. With a few trunk lines in successful operation it would not be long before they would be multiplied.

It is understood that these telegraph letters are sent by mail in envelopes in the usual manner, except that the envelope contains the prepared message ready to be sent through the transmitter, and thus the telegraph office becomes relieved of the preparation of the letters, which is not strictly a part of its business. When the system comes into general use business offices will have their own perforators, and it will become necessary for the operator to learn the telegraph alphabet as a part of his preparation as a stenographer and typewriter. The three-key perforating machine is comparatively inexpensive, but undoubtedly a machine could be devised at an early date, as an attachment to the present typewriter, for the purpose of perforating letters at the same time that they are being written by the typewriter in the usual way. This could be constructed to operate by the use of electro-magnets, and can be attached to a typewriter without interfering in any way with its operation. No extra power would be required, for this can be derived from an electric current which operates the attachment. The writing may be perforated at the present rate of speed of typewriting without the operator having any knowledge of the telegraph alphabet so far as perforating is concerned. This machine will cost more than the three-key perforator, but it would in a short time more than pay for the difference in cost on account of the great gain in speed, and also because it prints a copy of the letter which may be kept on file. Before these perforators are introduced into common use it will be necessary to establish offices in the immediate vicinity of the terminals of the trunk lines, to prepare letters for persons furnishing printed or written copy, as well as to furnish a printed translation when desired of letters received from the central office. The opportunity to obtain a cheaper rate for prepared letters will act as an inducement to those employing a stenographer to add a perforator to their offices.

Concerning the daily correspondence of the large business houses between cities which are the terminals of the trunk lines, it might be an advantage for them to have exclusive use of the line for a certain number of minutes daily at a certain fixed time of day, by subscribing and paying an annual rental to the company. Knowing definitely at what hour the mail would be dispatched daily, it would then be possible for each house to send by messenger its daily mail already prepared for transmission to the general transmission office, where it could be placed in boxes prepared for the subscribers, to be taken out and transmitted when its time arrives. The distribution at the receiving end of the line could be accomplished as now by the regular mail service.

In the limited use of rapid automatic intelligence transmission at present, the sending and receiving records are made upon prepared paper in the form of tape. In the larger volume of business which is being considered here, it does not seem certain that tape would be the best form for the sending and receiving paper. It would be an advantage to have the letters received upon sheets of paper with the dots and dashes arranged in parallel lines. Besides facilitating the reading, this form would be more convenient for mailing. It would also easily permit reference to any part of the letter at a glance. The amount of paper required by the use of sheet form instead of tape would be reduced, which is an item of importance where such a volume of business is being handled. Sending and receiving from the surface of a cylinder seems entirely practicable.

The telegraph line of the future will comprise substantial poles carrying a few copper wires worked to their full capacity for transmitting electric signals. The cost of maintenance of such a line when once constructed will be little more than for an ordinary iron wire now used, while its carrying capacity for intelligence at 3,000 words per minute simplex will be about equal to 160 wires used for hand transmission simplex. By duplexing the line, the carrying capacity is doubled and becomes 6,000 words per minute, which is about equal to 160 wires worked duplex, or to eighty wires worked by hand quadruplex.

It is thought that the influence which the inauguration of a telegraph letter system would have upon the existing telegraph and telephone business would be to increase rather than diminish it. Each of these services has its own special field of usefulness but little affected by the others. A new field would be occupied rather than an old field supplanted. The present telegraph and telephone would still have their natural field of operation, even though the best hopes for a telegraph letter service are realized.

A single line capable of sending 6,000 words per minute between New York and Chicago becomes a different kind of investment from a long-distance telephone line where the number of words per minute with the fastest rate a speaker can talk is very slow in comparison, and the charge is $9 for five minutes' use of this line.

It is not thought that the development of a rapid intelligence transmission service to the extent suggested could be accomplished before many years, nor indeed that the manner or means of this development should closely follow the lines indicated, but that something analogous to this development seems among the possibilities if not the probabilities of the near future.

The persistent efforts of Mr. Delany and the great system which he has developed are well known, and the ideas which he has advanced in regard to the applications of rapid systems are in the main in accordance with those stated herein.

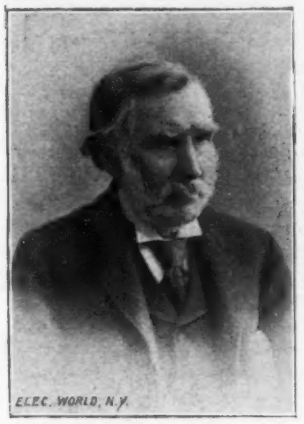
Direct Production of Electricity from Fuel.

A recent compilation of all the articles bearing on this subject and published during the last few years, abstracts and references to which were given in our "Digest," showed that since this department was started (February, 1893) there were no less than 120 such articles published. As most of these were given in abstract, as distinguished from mere references, the "Digest" forms quite a library on this subject. Besides these abstracts, a number of important articles and papers on the direct production were published in the other columns of The Electrical World during that period.

The First Electric Railway Passenger.

To the Editor of The Electrical World:

Sir:—I was born in March, 1822, at Ferryhill, Aberdeen, Scotland. My first schooling I received at the hands of an old sea captain named Andrew Davidson, who eked out a rather meager subsistence for himself and his elderly helpmate.



MR. WM. H. JOHNSTONE.

In 1836 I was apprenticed under a seven years' agreement to the moulding department of John Duffus & Co.'s Footdee iron works. My first acquaintance with Mr. Robert Davidson, chemist, optician, and the inventor of the electro-motor, was made in the Winter months of 1838-39. He was then delivering lectures on chemistry in the Mechanics' Institute, of which he and Middleton Rettie, a city merchant, were the most active promoters. To benefit the funds of the institution he, along with others, arranged to give some popular lectures, which they did, his part being a demonstration of his work, showing his motors, etc., in operation. The leaflets his printing press was throwing off are similar to that shown in your issue of October 18, 1890

On October 8, 1840, he opened an exhibition without charge, with a larger display, to see if he could not induce the general public to take interest in his work, but they were too much on

ELECTRO-MAGNETIC
EXHIBITION,
UNDER THE PATRONAGE OF THE
Royal Scottish Society of Arts.
GALVANI
Mr. ROBERT DAVIDSON'S
EXHIBITION OF ELECTRO-MAGNETISM,
AS A MOVING POWER,
IS NOW OPEN!
IN THE
EGYPTIAN HALL, Piccadilly.
THE MODELS AND APPARATUS COMPRISE THE FOLLOWING:
A LOCOMOTIVE ENGINE,
Carrying Passengers on a CIRCULAR RAILWAY.
A PRINTING MACHINE AND TURNING LATHE.
A SAW MILL.
A MACHINE for COMMUNICATING the ELECTRO-MAGNETIC SHOCK.
AN ELECTRO-MAGNET!
The largest ever made. It weighs upwards of 500 Pounds and will suspend many Tons.
A GALVANIC TELEGRAPH.
THE COMBUSTION OF METALS,
Attended in each case with Splendid Coruscations, peculiar in color to the Metal operated upon, &c. &c.
MODEL OF THE FLYING MACHINE
MODEL OF AN ÆRIAL CARRIAGE,
By Sir GEORGE CAYLEY.
Balloon Navigation Illustrated.
OPEN FROM 12 TILL 6, AND FROM 7 TILL 9.
Admission, ONE SHILLING.
Children under 12 Years of Age, SIXPENCE.
PRINTED BY ELECTRO-MAGNETISM.

FACSIMILE OF ONE OF DAVIDSON'S HAND-BILLS, 1840.

pleasure bent, that being the day of the exhibition of the Royal Highland Society, and no one save myself looked in to give this really clever man the slightest bit of encouragement by their presence. I had, however, been looking forward to see the "Lightning Coach," as it was then advertised and called, so went early. With him I spent the greater part of the day with much pleasure to myself as well as profit.

It was then I had my first ride on an electric car, Mr. Davidson acting as the motorman himself.

I could not help feeling that my company, humble though it was, afforded him a slight amount of pleasure in return, for it was one of his delights to come in contact with youth so that he might have opportunity by instructing to interest them in the as yet unrealized possibilities that had constituted the labor of his lifetime.

After my return to my native city in 1851 I called on him with a nephew of mine, an optician and a nautical instrument maker, so that he might get the benefit of his valuable experience. At his chemical works I found him still the "master," the "mechanician," the "philosopher"and the "philanthropist."

He had several telescopes of about 4-inch specula that he had constructed, and had under construction, and almost finished, one of 15 inches diameter.

We had some talk of his past experience, but not a word of recrimination or bitterness at his ill-deserved treatment did I hear from him.

Mr. Davidson died November, 1895, loved, but unhonored and unsung.

WM. H. JOHNSTONE.

MOUNT PLEASANT, VANCOUVER, B. C.

Profitable Day Load in Alternate Current Systems.

To the Editor of The Electrical World:

SIR:—In your issue of April 24 you make certain criticisms upon a suggestion embodied in an article in the same paper from my pen, which have certainly pointed out difficulties, but not of such magnitude in my opinion as to be insurmountable.

With regard to your criticism concerning the overlap of the power and light loads, there is no doubt that the fact is perfectly true. It is to be assumed that any well-designed station will have a slight margin of power, say 25 or 30 per cent., over its average load. Now supposing that for a period of three hours the loads overlap, that the average load is doubled, the station overload for that length of time would be but 70 per cent. In these days of competition a dynamo that will not successfully carry 70 per cent. overload for three hours stands but little show where the award of a contract is in the hands of competent engineers. I think that most engineers will agree that the conditions I have assumed in making this point are extreme ones, and that probably the machines would not be called upon for such exacting performances. An intelligent preliminary survey should anticipate all of these conditions, and while it is easily possible that it would be judicious to build the plant somewhat larger than in ordinary practice, it is highly improbable, in my opinion, that this increased installation would be so large that, as you say, the apparent economy would probably disappear.

That careful distribution of the circuits of a two or three-phase station should prevent serious unbalancing has always been a prominent and powerful argument with the makers of such dynamos. By means of the interchangeable system which I suggested as applicable, this unbalancing effect having been reduced to a minimum as indicated, would only have to be endured during the lap of load. A little ingenuity would design a pair of machines whereby the field of one of them could be shifted the proper angular distance instead of the armature. When the power load came off it would only be necessary to turn a hand wheel and shift the field of the machine and the phase of the current to synchronism with its mate, and then by means of a single switch multiple the entire combination. This could be done and no customer need know that anything had transpired.

GEORGE T. HANCHETT.

Exhibition in Turin in 1898.

For the occasion of the National Exhibition which will be held in Turin, Italy, in the summer of 1898, to celebrate the fiftieth anniversary of the proclamation of the Italian Constitution, the special department of electricity is soliciting exhibits from all countries. The electrical section will be divided into eleven classes, including all of the applications of electricity in the arts, historical exhibits, etc. The large amount of unemployed hydraulic power in Italy is said to afford a considerable field for enterprising electrical engineers. Communications and applications for space should be addressed to Angelo Alasia, 3 Via San Maria, Turin, Italy.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Alternating-Current Machinery. DUBSKY. Lond. *Elec.*, April 23.—The conclusion of his article, (see *Digest*, last week). He discusses three-phase machinery; the Danube Steam Navigation Company has replaced all its steam engines with three-phase motors; the frequency chosen was 15, on account of the slow speed required by the motors, the fastest two-pole motor running at 900 revolutions; a photograph of the 250-hp alternator is shown, the speed of which is 150; the same machine generates continuous currents, for which carbon brushes are used; the collector rings are all glass-hard steel and have metal brushes; the same machine is used for lighting, and as the grounds are too large a two-wire system could not be used; according to a simple and ingenious system devised by Kando the same machine distributes on a three-wire system without any modification of the machine itself; the neutral point of the three-phase winding has a fixed potential symmetrically between the maximum and the minimum potentials of the other winding; the potential at each commutator brush of the continuous-current side is exactly equal to the maximum or minimum, hence the outer wires of the three-phase system are connected to the brushes, and the third wire to the neutral point; it is unnecessary to run the third wire from the continuous side of the dynamo, as the neutral point of any of the motors will do for the third wire connection, but if no motor is near a three-phase transformer or conducting coil can be used instead; as the potential of the neutral point is not influenced by the currents in the three-phase conductors and has the same constant value, the drop of voltage on this return wire is quite independent of the alternating currents which are flowing through these conductors, which is of special advantage in a combined power and lighting system; the system has given very satisfactory results; a diagram shows the connections. These combined continuous and three-phase dynamos work regularly in parallel on both sides of the armature; the continuous-current sides are first paralleled and when the loads are equally distributed the three-phase sides are switched together at synchronism; more than 30 motors are in use in this plant, the largest being 60 horse-power; some of the new ships of the Austrian Navy are provided with a similar system, the combined dynamo and engine of which is illustrated. A brief description is given of a rolling mill plant, which is a great strain on the motors; it has been run for more than a year and the power is transmitted for 1.5 miles from a 160-hp, three-phase dynamo, the frequency being very low; the transmission and motors run at 1000 volts without any intermittent transformation. When both light and power are to be distributed from one set of mains they use a frequency of 42, which is the lowest suitable for lighting; an illustrated description of such a machine is given; by using the well-known Scott arrangement three equal voltages with a phase difference of 120 degrees is produced, the machine having two distinct armatures whose phases differ by 90 degrees; one armature is wound directly for the main pressure of the generator, and the other has a number of turns 0.867 times the number of the other; as the sectional areas of the iron are exactly equal in both, there will be an equal magnetic flux in both windings; the terminal of the armature with the smaller number of turns is connected to the middle of the other winding, and the three remaining terminals allow the commutation of three-phase currents; in this way, crossings of the connections are completely avoided, which is a great advantage for high-pressure work; if three distinct series of coils were used to generate the three phases, the crossings of the single windings could not be avoided and the machine would be much more complicated; it is also possible to obtain single-phase currents from these generators or single phase and three phase at the same time. The three-phase motors are briefly described; below eight horse-power they use a short-circuited armature, the starting current under full load being about three times the normal full-load current, and the starting torque somewhat larger; to show the good insulation, a one-hp, three-phase motor was worked completely under water several hours a day during a recent exhibition; the voltage was 300; above eight horse-power the motors are started with a resistance; the primary has a two-phase and the secondary a three-phase winding, so that the torque is more nearly equal for different positions of the armature; both are drum windings; curves of the three-phase motor are given.

Armature Reaction of Foucault Currents. BESSO. *Elek. Zeit.*, April 15.—A brief criticism of the article which was noticed in the *Digest*, April 3. He states that the author of that article has not given a proof of his proposition; concerning this proof he states that the tubes of force not only cause changes in the flux of induction, but are also subject to important changes; the comparison with stationary transformers does not apply; several other corrections are noticed.

Relative Size, Weight and Price of Dynamos. WILSON. *Jour. Inst. Elec. Eng.*, April.—A reprint of the complete paper and discussion which was noticed in the *Digest*, March 27.

Six-Pole 7-kw Dynamo.—Lond. *Eng'ing*, April 16.—A brief but well-illustrated description of a machine made in Holland, to be run at 450 revolutions.

Alternators in Parallel. WOODBRIDGE. *Elec. Eng.*, April 28.—The first part of an article pointing out the advantages of paralleling alternators, which are just beginning to be realized by managers; this is followed by some general hints concerning the driving of the alternators and the connection in parallel under different circumstances.

Repairs of Electrical Machinery. HARRIS. *Amer. Mach.*, April 22.—The beginning of a series of articles of a practical nature, the present portion dealing with field coils.

LIGHTS AND LIGHTING.

Theatre Lighting.—Lond. *Elec. Eng.*, April 25.—A brief illustrated description of the installation in the new Glasgow Empire Palace.

Manufacture of Incandescent Lamps. DE LAND. *Elec. Eng'ing*, April 15.—The beginning of an article in which he describes, without illustrations, the manufacture of squirted cellulose lamp filaments.

Electric Lighting in British Guiana. VYLE. *West. Elec.*, May 1.—A reprint of the article noticed in the *Digest*, Feb. 13.

POWER.

Transmission of Power to Long Distances. NICHOLLS. Lond. *Elec. Rev.*, April 23.—A brief discussion of the recent paper by Esson; he thinks that that author raised several points which are opposed to the practice of the largest firms; he regrets that power transmission over short distances by alternating currents was not also discussed, as that is of more importance in England, where there are but few opportunities for long-distance transmission; he thinks it open to question that for short distances the direct current is better, as small induction motors, up to nine horse-power, start on full load and are easily capable of being reversed; he discusses briefly the copper economy of the three-phase system.

Continuous Current Transmission. HECHT. Lond. *Elec.*, April 23.—A communication calling the attention of those who are interested in continuous-current transmission to two installations near Neuchatel, in Switzerland, where continuous current is transmitted at 8000 volts, which is to be increased to 14,000.

Electrical Mining Hoist.—Lond. *Elec.*, April 23.—A brief illustrated description of the one used at Blanzy, in France; a 40-hp non-synchronous motor is used and the load is drawn up an inclined plane; it is run at 5000 volts.

Electricity in Mining on the Pacific Coast. PERRINE. *Elec. Eng'ing*, April 15.—A short article explaining why progress has not been more rapid in this direction; there are special problems which should be attacked by the electrical engineers, and if these difficulties can be solved there will be much more rapid progress there.

Power Transmission Project in the Mohawk Valley. DUNLAP. *West. Elec.*, May 1.—A notice stating that a company has been formed to develop the power of the Trenton Falls, N. Y., for furnishing light and power to the city of Utica; no description of the system to be used is given.

Details of the Fresno Plant. DUTCHER. *Jour. of El'ty*, April.—An illustrated article giving some of the details of the plant, which it is claimed have not before been published; it includes good diagrammatic illustrations of the switchboard.

Electric Chain Coal-Mining Machine.—Eng. & Min. Jour., April 24.—A description of the latest form of the Jeffrey machine, the principal improvement in which is in the new motor, which is of the multipolar, iron-clad type.

TRACTION.

Accumulator Traction—Elek. Anz., April 4.—A short illustrated article describing some details for use in the mixed system (in which the accumulators are charged from the trolley lines). When the cars run on the trol-

ley the voltage is 500, and when run on the battery 400; to prevent this from affecting the lights, an arrangement, which is shown, connects a resistance or an additional lamp in series with the other four, to be used when the trolley current is used. Another device disconnects the trolley pole and earth from the batteries when the car is being run by them, in order to avoid the possibilities of danger from contact with other wires. Another improvement consists in inclosing the batteries hermetically, in order to prevent injurious effects from the gases generated during the charge.

Recent Developments in Electric Traction. BAYLOR. Lond. *Elec. Eng.*, April 23.—The conclusion of the reprint of his paper (see *Digest*, last week); he discusses electric brakes. The discussion was brief and contains nothing of importance; Dawson stated that it is now recognized in the United States that a much better system than the three-wire system was to use the high tension alternating or three-phase current with sub-stations containing motor generators; on the Continent also the sub-station method was preferred.

Huddersfield and the Municipalization of Tramways. POGSON. Lond. *Elec. Eng.*, April 23.—A reprint of a long abstract of a recent paper. In no single instance had the public spirit of the municipality been shown to a greater advantage than in connection with the railway; there is no other instance of a municipality having constructed, operated and developed its own tramway system; the article refers to the management and costs rather than to a technical description.

Vienna and Milan.—Lond. *Eng.*, April 23.—Brief descriptions of the electric railway system.

Safety Appliances on Railway Generators. MOFFAT. *Elec. Eng.*, April 28.—A short article on the way in which railway generators are protected in large stations, illustrating it with an examination of the cause of the recent fire in Philadelphia, where, if the circuit-breaker had been on the negative side, as it should have been, the short-circuiting could not have occurred, as the circuit would have opened; another source of danger is the grounded field magnet; there is no good reason why it should be grounded, although some makers construct it in that way.

Comparison of Conditions in Europe and the United States. SULLIVAN. *St. Ry. Rev.*, April 15.—A long article making comparisons of the conditions and showing that they are not the same; he concludes that the people of the United States could better afford to subsidize the street railroads and maintain the present conditions at any price; also that European cities have a grave problem to obtain the same conditions as here.

Power House Record.—St. Ry. Rev., April 15.—A tabulated statement of the cost of the power and the distribution of this cost for the past six months, for the Metropolitan Railroad of Washington.

Columbia & Maryland Railway. HUFF. *St. Ry. Rev.*, April 15.—A continuation of his illustrated description; some of the details of the overhead construction are illustrated and described.

Metropolitan Conduit Line in New York.—St. Ry. Rev., April 15.—A brief illustrated description of the conduit to be used; the Lenox system, with some alterations suggested by experience, will be used, of which illustrations are given.

Chicago Suburban Co.—St. Ry. Rev., April 15.—A brief description of the construction of the lines of this company running to the west and southwest suburbs of Chicago.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Storage Battery Engineering Practice. APPLETON. *Elec. Eng.*, April 28.—A continuation of his serial (see *Digest* last week). The advantage of the cadmium test is to ascertain at the end of a charge or discharge whether both plates are in a similar condition or not; it requires very accurate measurements; at the end of the discharge the E. M. F. between the positive and the negative plates, as also between the positive and the cadmium, should be measured, and the difference will be the E. M. F. between the cadmium and the negative; the negative should never be discharged beyond the point where this difference would be 0.30 volt, except at high rates of discharge, when 0.35 may be considered the limit; when the voltage of the cell drops to the limit before the negative reaches this point it is the positive which is exhausted; the same test may be made at the end of the charge, which is when the reading between the cadmium and negative is zero. Regarding the manufacturer's guarantee of a battery, he states that in many cases this is an injustice to the manufacturer, as the purchaser then neglects the battery, feeling that he is protected; it becomes the question of guaranteeing the man in charge; no other class of machinery calls for such a guarantee; the majority of the owners of plants could maintain the battery at a much smaller amount than the manufacturers must charge, as the latter is then relieved of the responsibility of the attendant. He then discusses the application of storage batteries to isolated plants; these may be private residences where convenience is more important than economy, or office buildings, where economy is the chief object; in the former the generator is usually a gas or oil engine; the battery should then supply one-half the lamps wired for eight hours on one charge; thus one charge will take care of the lighting for two or three days; the capacity of the engine and dynamo should equal that of the battery at the eight-hour discharge rate; when working in parallel, all the lights could be run for eight hours; for installations up to 200 lamps the best arrangement is a plain shunt wound dynamo of 150 volts for a 110-volt circuit; a battery of 58 to 60 cells is required; the best method of regulation is by counter E. M. F. cells consisting of plain lead plates in acid; 18 of these are sufficient for all purposes, or when the lamps are not to be used while the battery is being charged, then this may be reduced to seven cells; a diagram shows the connections for such a plant.

Storage Battery Station in Boston.—Elec. Eng., April 21.—A brief illustrated description of the Scotia Street station of the Boston Edison Company; it is their third battery plant and differs from the others in having no generators; it supplies the fashionable resident district and enables the company to supply current for both light and power in that district, and also to take the current from the most economical generating station at the water front, at the same time improving the economy by increasing the night load on this station; the battery sub-station is two miles from the generating station; it has fulfilled all its expectations so far.

Alternators in Parallel. LINCOLN. *Amer. Elec.*, April.—Neither wave form, field excitation nor any other electrical condition can have any effect on the division of the load between two alternators running in parallel; the electrical energy delivered by an alternator is equal to the mechanical energy put in, less the loss in the alternator, and the amount of energy put in depends solely on the valve opening of the engine or water wheel, as the case may be; the amount of this valve opening is independent of any electrical condition when the alternators are running in parallel, because the alternators must run in synchronism, and a change in the speed of one necessitates a change in the speed of the others; consequently, an adjustment of the governor is the only way to shift the load from one alternator to the other; in order to give a certain E. M. F., an alternator must have a given amount of magnetizing effect, and if it does not get that magnetizing effect from its field it must draw it from its own armature in the form of an armature reaction, which assists the field; this condition means an exchange of idle current between the armatures, the amount depending upon the difference in field excitation.

Alternating Current Appliances.—Amer. Elec., April.—The transformer is described, and explanations are given for determining the method of connecting up subdivided secondaries and primaries, where these connections are not indicated. It is explained how it may be experimentally determined in a simple way, if a transformer is connected to a voltage or frequency higher or lower than that for which it was designed; tests are given to determine by a simple means what are the proper connections for putting transformers in series or multiple in the absence of proper markings.

Equalizer on Polyphase Generators. WILCOX. *Amer. Elec.*, April.—He has been running two 100-kw tri-phase machines, compound wound, for nearly a year without an equalizing connection; the machines are in separate stations nearly four miles apart, are over-compounded for about 10 per cent., and are regularly run in this manner. Energy is transmitted at 2300 volts over three No. 6 B. & S. wires, and is distributed for lighting at both ends of the line; the station is operated by water power, with a steam auxiliary when needed.

Four-Wire, Three-Phase Secondary Distribution.—Amer. Elec., April.—In this well-known system a fourth wire is led from the neutral point of the generator or transformer, thus forming the equivalent of a six-wire three-phase system; the size of the neutral wire depends upon the balance of the system; a simple diagram is given whereby the amount of current flowing in the neutral may be determined from the currents flowing in the main wires.

Combining Power and Lighting Plant. RIDER and SPENCE. *St. Ry. Rev.*, April 15.—A brief abstract of the articles which were noticed in the *Digest*, Dec. 25 and Jan. 9.

Georgetown. HOPKINS. *Elec. Eng.*, April 28.—A very brief, illustrated description of the plant of the Potomac Lighting Company (District of Columbia) which supplies Washington with about 200 arc lights and furnishes power for five small railroads.

Coöperative Lighting Plant. SCHOENTJES. *Elec. Eng.*, April 28.—A brief description of the small plant at Borsbeke, Belgium.

Public Park Lighting Plant. HELDT. *Amer. Elec.*, April.—An illustrated description of the plant for the chain of parks and connecting boulevards on the west side of Chicago.

Design and Construction of Electric Power Plants. ARNOLD. *West. Elec.*, May 1.—An editorial statement that the lectures by Arnold, which were noticed in the *Digest*, April 10 and 17, are not a "reprint" (presumably meaning that they had not appeared in print before, although they had been delivered); the statement is also made that considerable new material is embodied in that publication of these lectures.

WIRES, WIRING AND CONDUITS.

Drying Air Cables. PETSCH. *Elek. Zeit.*, April 8.—An article in which he points out the advantages of forcing dry air through paper and other cables in which there is an air space between the wire and the lead pipe in order to increase the insulation and to repair the damage done by a leak in the lead covering; it is of use also in discovering a leak by means of the

whistling noise made by the escaping air, which is in that case forced in at both ends of the cable, the leak being repaired after all the moist air has been driven out, which requires several hours; in France, where this method is used, the standard insulation is 1000 megohms per kilometer; the fault is also located electrically; a reference is given to a description by Wietlisbach in his articles in *Electrical Engineering*, where the system is described; he then gives an illustrated description of the apparatus which is in use in Paris, and with which very good results have been obtained; as it is desirable to send the compressed air into the cable from both ends, a compressed air pipe is sometimes led to the distant end; it is also thought desirable to use portable compressed air tanks for some of the distant ends.

Most Economical Distance Between Poles for Overhead Lines. Stark and Schwarz. *Elek. Zeit.*, April 8.—A short article intending to show that the usual distance between poles, namely, 75 to 100 feet, is smaller than is necessary and that greater economy in the cost of installation can be obtained with a greater interval. They show that it is quite worth while to make calculations very carefully to show the best distance; they base their calculations on the tension, the transverse effect of it on the pole and the wind pressure, a distinction being made between straight lines and curves; a general solution of the problem cannot well be made and they therefore use an example involving the usual conditions, giving the results in the form of curves for a pole of I cross-section and one of circular cross-section, the abscissas being the distance between the poles and the ordinates the required weight of material in the poles, which is proportional to their cost; with the I poles the economy in material for a distance of 50 m as compared with 25, is 28,77 per cent., and with poles of circular cross-section of wood or iron it is 36.9 per cent.; above 50 m the economy would be too slight to be of importance; these curves would deviate in general but little for other wires and wind pressures.

Fuses for Branch Circuits. Sharpsteen. *Elec. Eng.*, April 21.—He points out the want of attention which is given the subject of the proper fuse lengths for incandescent lighting circuits; he shows how easily a secondary circuit may be subjected to 1000 volts or more and how this can act to maintain an arc across the fuse gap, setting fire to the building or cracking the porcelain fuse block; it does not follow that the main fuse will blow in such a case, as the current need not be great; he describes two cases which have come under his notice; it need not seem strange that the current may find its way to the ground on the opposite side, as there can easily be a small leakage through trees and other like contacts on long overhead lines; he is surprised that fire underwriters allow branch blocks with small gaps to be used, and claims that each of the branch circuits should have a pair of fuses long enough to break a current coming from the highest voltage circuit in the city.

Calculation of Wiring.—Amer. Elec., April.—The usual wiring formulas are deduced from fundamental considerations, and their application shown to the calculation of polyphase circuits; it is shown that each wire of a three-phase circuit, leaving aside inductance, should have one-half the cross section of one of the conductors of a continuous-current circuit transmitting the same amount of energy, allowance being made for the idle current. The numerical calculation is given for a line transmitting 1000 horse-power at 10,000 volts over 30 miles, with a drop of 10 per cent.

Calculation of Circuits. Perrine. *Elec. Eng'ing*, April 15.—A continuation of his serial; he discusses the connection of incandescent light circuits with feeders.

Underground Conduit.—West. Elec., April 24.—An illustrated description of the construction used by the Edison Company, of Chicago, on Jackson Street, which is claimed to embody every advancement known to the art to-day.

Wire. Orton. *Sibley Jour.*, April.—A short article describing the manufacture of metallic wire.

ELECTRO-PHYSICS AND MAGNETISM.

Cathode Rays in an Alternating Magnetic Field. Fleming. Lond. *Elec.*, April 23.—In a former article (see Electrical World, Jan. 16, p. 97) he showed the effect of surrounding the maltese cross Crookes tube by a magnetic coil through which a continuous current passed; in the present article he describes experiments with the same arrangement, but with alternating currents; the coil was placed between the cross and the end of the tube; the shadow flickered about, rotating first one way and then the other, throwing superimposed shadows which seemed to be formed of one which was sharply marked and which rotated backward and forward without any reference to the frequency of the current; when a cathode ray is projected along a magnetic field in the direction of the lines of the field it is compelled to follow a helical path, which is right or left-handed according to the direction of the field; in a continuous field there is a rotation, but if the field is alternating it is a matter of chance whether the twist will be right or left-handed, and hence a sort of waggling shadow is produced; similar results were obtained from the Wimshurst machine, showing that the discharge is intermittent. Another curious result is obtained, which in one form was noticed by Birkeland; instead of a cross a slit in a disc was used; with a continuous current in the coil the green line shadow was drawn out into a curved band with crossed black lines, showing that the cathode ray consists of different constituents rotated in different degrees by the field.

Law of the Photographic Action of the X-Rays. Vandevyver. *Jour. de Physique*, January; noticed briefly in the *Jour. Inst. Elec. Eng.*, April.—He gives a formula for the time of exposure (it appears to involve a topographical error in the abstract and is therefore not reproduced here). He then experimented to find whether the action on the photographic plate varies according to the inverse square law and found that this law did not hold good; he came to the conclusion that the action of X-rays varies inversely as the distance of the tube from the photographic plate.

Electrification of Gases by Röntgen Rays. Rutherford. Lond. *Elec.*, April 23.—A reprint of the article noticed in the *Digest*, April 24; it is also commented on editorially. He made it practically certain that the diselectrification of a charged surface and conduction through a surrounding gas are caused by a process of ionic dissociation of the substance of the gas itself.

Action of Electric Discharges on Gases. Villari. *Comptes Rendus*, March 15; abstracted briefly in Lond. *Elec.*, April 23.—An account of some experiments on the action of the electric discharge and X-rays on gases; the electric discharges in ozonizers does not communicate to bodies the property of discharging electrified conductors; he attributes this to the electric charges accumulated by the discharge on the glass, which disappears slowly.

Do Röntgen Rays Make Air a Conductor? Minchin. Lond. *Elec.*, April 9.—He holds that they do not; he refers to a previous communication in that journal about a year ago, in which some experiments were described and in which he gave a table of the metals according to the sign and the magnitude of the charge conferred by the Röntgen rays, the table agreeing closely with the ordinary table of the E. M. F. series of metals immersed in a liquid. According to J. J. Thomson's theory the air which is traversed by Röntgen rays becomes a conductor, and it was at first thought that this was correct, but he has since questioned it and conducted a series of experiments, which are described, and which gave a negative result. The paper is discussed editorially in the same issue.

Conductivity of Röntgenized Air. J. J. Thomson. Lond. *Elec.*, April 16.—A brief communication referring to some recent experiments of Minchin (see above). It is thought that these do not disprove that air becomes a conductor, but rather confirm the statement that the conduction does not obey Ohm's law; it is clear that calculations based on the assumption that Ohm's law is true are hardly to be realized.

New Use for X-Rays. Heycock. Lond. *Elec.*, April 9; reprinted in *El'ty*, N. Y., April 21.—A brief abstract of a Royal Institution lecture on metallic alloys and the theory of solution. When a salt, such as potassium permanganate, is dissolved in water and the mixture slowly frozen the salts separate themselves from the ice and form a core in the centre; it has always been very doubtful whether the metals composing alloys form a homogeneous mixture or exist in distinct particles capable of being separated from each other; to test this he made an alloy of sodium and gold and allowed it to cool very slowly, after which a very thin section was cut and photographed by means of Röntgen rays, which showed that the sodium had crystallized out from the general mass; this he believes opens up a wide field of research in microscopic photography; it is suggested that X-rays might be used in a similar way to study the true nature of various brands of steel and iron, that is, mixtures of iron and carbon.

Experiments with Cathode Rays. Swinton. Lond. *Elec.*, April 23.—A complete reprint of the paper, a long illustrated abstract of which was published in The Electrical World, April 24, p. 528.

Discharge Rays. Hoffman. *Wied. Ann.*, 60, p. 269; abstracted in the *Proc. Lond. Phys. Soc.*, April.—An abstract of the article, which is presumably the same as the one noticed in the *Digest*, April 3.

Point Discharges. Wesendonck. *Wied. Ann.*, 60, p. 209; abstracted in the *Proc. Lond. Phys. Soc.*, April.—Description of discharges with Leyden jars, showing the effects of positive and negative points.

Discontinuous Conductors. Vicentini. Lond. *Elec.*, April 23.—A translation, apparently in full, of the artice noticed in the *Digest*, March 10.

Electromagnetic Theory of Light. Rayleigh. Lond. *Elec. Eng.*, April 23.—A brief abstract of a reference to this subject in a recent lecture on electrical vibrations.

New Action of Magnetism on Light. Kalischer. *Elek. Zeit.*, April 15.—A short article referring to the recent discovery of Zeeman with references to the Lorenz theory and the recent comments by Lodge.

Oscillatory Discharges in Derived Circuits. Magri. *Nuovo Cimento* 4, p. 321; abstracted briefly in the *Proc. Lond. Phys. Soc.*—Numerical results are given which show that in derived circuits of the same material and diameter and such that the resistance to continuous current and their geometric coefficient of self-induction are proportional to the length of wire of which they are made, the resistance to a Leyden jar discharge is proportional to the length of the wire, whatever be the period or the difference of potential; in other words, such derived circuits present a resistance to Leyden jar discharges which is proportional to the impedance as derived from the formulas of Maxwell and Rayleigh.

Oscillatory Charge of Condensers. Tallqvist. *Wied. Ann.*, 60, p. 248; abstracted in the *Proc. Lond. Phys. Soc.*, April.—When a condenser is charged in circuit with a coil the charging current is oscillatory when the resistance of the circuit is below a certain limit, which is given by the in-

ductance of the coil and the capacity of the condenser; he also found a method of comparing inductances and capacities by measuring the period of the oscillatory charging current; the formulas giving the relations between these quantities are the same as for discharges, except that the constants are different; experiments give results agreeing with the theory that the curves were sensibly sinusoidal; the method may be used for measuring either inductances and capacities if either of them is known.

Short Hertz Waves. RIGHI. *Proc. Lond. Phys. Soc.*, April.—An abstract from the Italian, in which are given the details of experiments with waves 2.6 cm in length. A foot note to the abstract states that Hebeden worked with waves six mm in length (see *Wied. Ann.* 56, 1).

Electrical Conductivity of the Ether. TROWBRIDGE. *Amer. Jour. of Sc.*, May.—A short article describing some experiments with the measurement of the resistance of spark gaps. In the April number of that journal (see *Digest*, April 10) he described experiments which led him to the conclusion that the chief resistance in a highly rarefied medium is at the surface of the electrodes, and when this is overcome the ether offers but little resistance; the method which he uses is well adapted for the study of electrical discharges, or the comparison of resistances by the estimation of the damping of the oscillations. The electrical circuit is provided with two gaps, one in the gas, while the other is photographed; with cadmium terminals it enables the resistance of a spark in air or rarified media to be estimated to one-half an ohm; he used the Planté rheostatic machine, which he considers very useful and very efficient; he found that at least 100,000 volts were necessary to produce the Röntgen-ray, and that they were more intense with the higher voltage; the discharges were oscillatory when such rays were produced; the energy at the moment of emission of the rays was not far from 3,000,000 hp acting for one-millionth of a second; he found no difference of resistance between a six-inch spark and one of three inches; the compression of the air to four atmospheres made no difference in the resistance, neither the differences in the material of the gas; the difference of resistance between spheres and points or planes seemed to be inappreciable; heating the gap made no change in the resistance nor did a magnetic field affect it; he could not detect any effect of ultra violet light; it may be maintained that a lightning discharge of one-mile under certain conditions encounters no more resistance than one a foot in length; in other words, Ohm's law does not apply for spark gaps; disrupting discharges appear to be of the nature of voltaic arcs, each oscillation being an arc; a minute spark precedes the formation of this arc, the medium being first broken down, after which the arc follows; he believes that this process also occurs in the vacuum and that absolute contact is not necessary to start the arc; his experiments lead him to the conclusion that under very high electrical stress the ether breaks down and becomes a good conductor.

X-Ray Arc. WOOD. *Elec. Eng.*, April 28.—A brief description of the new method of producing X-rays by means of a small arc, which he described in an article noticed in the *Digest*, April 17, and which he has been using for the past three months, having described it several days prior to Tesla's announcement of the same discovery; an illustration is included; the arc is formed between a knob and a flat disc which closes one end of the bulb; the vacuum may be somewhat lower than that usually found in Crookes tube and a spark gap in the external circuit seems necessary; he has generally used the current from a 12-plate Wimshurst machine. He thinks it likely that tubes may be made on this principle small enough and sufficiently well insulated to be introduced into the cavities of the body; with the one shown, in which the bulb is less than one inch in diameter, he has seen the bones of the forearm quite distinctly.

Therapeutics of the X-Rays.—Elec. Rev., April 28; reprinted from the London *Lancet*. A brief mention of an experiment by Vortet, in which guinea pigs were inoculated with tubercle; those treated for one hour a day during 25 days did not show the illness which those not treated did. Bausset treated a long-standing case of pulmonary and abdominal tuberculosis; the action of X-rays was followed by apparent benefit not other wise accounted for.

Röntgen Rays. SELLA and MAJORANA. *Elec. Rev.*, April 28.—A translation in abstract of the article which was noticed in the *Digest*, Feb. 6.

Formulas for Calculating Magnetic Coils. GRAY. *Rose Technic*, April.—An article in which he works out the solution, with comparatively simple formulas, of a number of typical problems which occur; in each case the M. M. F. and one or some of the other conditions are given, and it is required to calculate the pounds of wire and number of turns that comply with the given conditions; the five problems are for dynamo magnets and the sixth for the calculation of the number of turns on a transformer which will make the leakage current a given value.

ELECTRO-CHEMISTRY AND BATTERIES.

Commercial Electrolysis of Fused Salts. CCHENEVEAU. Lond. *Elec. Rev.*, April 23; a very brief abstract from the *Rev. de Physique et de Chimie*, Vol. 1, p. 55.—It refers to a lengthy trial which is at present being made in Modane, France, of the VAUTIN process in which molten lead forms the cathode; the difficulties originally encountered have been overcome by electrolyzing a definite mixture of sodium and lead chlorides, the bath being continually fed with the same; the anodes receive only a part of the current; a portion of the liberated chlorine acts on the lead and the lead chloride formed diffuses in the bath; by regulating the current passing through the molten lead the amount of lead chloride formed can be regulated; the best current density is 0.7 amperes per sq. ft. and produces 0.081 kg of chlorine and 0.054 of sodium per hp hour with an E. M. F. of seven volts. Peroxide of lead and alloys of sodium or barium with tin or zinc may also be obtained by this method.

Heat Transforming Battery.—Lond. *Elec.*, April 23.—An unfavorable editorial criticism of the Essick battery (see ELECTRICAL WORLD, April 10, p. 486). It states that there is no evidence whatever that this cell transforms heat into electrical energy; it has been long known that the warming of electrolytes increases their conductivity and by this means the internal resistance may be reduced, "but whether the cell be cooked or raw, hot or cold, all the energy that is developed is produced by the consumption of zinc, and must be paid for accordingly." If the heat is supposed to increase the voltage then according to Carhart's temperature coefficient a temperature of 12,000 degrees C. would be needed to bring its E. M. F. up to two volts.

Ribbe Accumulator. FITZ GERALD. Lond. *Elec. Rev.*, April 23.—A brief comment on this accumulator, partly favorable and partly sceptical; he thinks that under certain realizable conditions the plates would stand a great amount of rough treatment, but thinks that it is at present in a somewhat primitive stage.

Commercial Production and Application of Ozone.—Lond. *Elec. Rev.*, April 23.—An abstract of some of the recent articles of Andreoli; it does not appear to contain much more than was given in the *Digest* abstracts of the original publications.

Extracting Metals from their Ores. SCHNABEL. Lond. *Elec. Rev.*, April 23.—An abstract from a report in the *Chemiker Zeitung*, Vol. 20, p. 595, referring to the electrical extraction of non-ferrous metals, dealing with zinc, gold, silver, nickel, copper, and aluminium; it mentions chiefly the names of the processes in use, including very brief descriptions.

Electrolytic Separation of Metals. PAULI. Lond. *Elec. Rev.*, April 23; a note referring to an article in the *Elektro-Chemiker Zeitung*, Vol. 3, p. 100.—If a solution of mixed salts surrounds the cathode, that metal will first be deposited which, for the given electrolyte, exerts the least osmotic pressure; a separation of metals is thus possible without the use of dynamos.

Electro-Coppering of Aluminum. MARGOT. *Beiblaetter*, Vol. 21, No. 1; noticed briefly in the *Jour. Inst. Elec. Eng.*, April.—Treat with the carbonate of an alkali, then thoroughly wash and immerse in warm hydrochloric acid of about 1 to 20; after a slight rinsing in clean water immerse in a dilute slightly acid solution of sulphate of copper, and after again washing, into a galvanic bath.

Molecular Conductivity of Dilute Solutions. JOUBIN. *Comptes Rendus*, 124, p. 228, abstracted in the *Proc. Lond. Phys. Soc.*, April.—Experiments and deductions therefrom concerning the limiting value of the molecular conductivity; he suggests a definition of the electrochemical equivalent as the quantity which, dissolved in one cb. cm. of water, gives the molecular resistance the limiting value in electromagnetic values which is $4\pi 10^{10}$.

Electrolytic Conductivity of Salts. FRITSCH. *Wied. Ann.*, 60, p. 300; abstracted briefly in *Proc. Lond. Phys. Soc.*, April.—Salts conduct like electrolytes and not like metals. Salts with traces of other salt similarly constituted behave like solid solutions; plates of the salts being examined, were pressed between plates of the metal forming their base and the resistance was determined by the substitution method.

Optics and the Theory of Ions. ZEEMAN. *Rev. Gen. des Sciences*, April 15.—A short article in which he discusses the question of whether a magnetic field can modify the vibration period of light; experiments seem to show clearly the real existence of ions.

Electrocyanide Gold Extraction. KEITH process. *Eng. & Min. Jour.*, April 17.—A brief description of this process, which is being tried in South Africa (the process was referred to in these columns several years ago); his improvement consists in adding a certain amount of cyanide of mercury to the cyanide solution; the best results are obtained with 0.05 per cent. of potassium cyanide and 0.025 per cent. of cyanide of mercury; this mixture is claimed to operate much faster; data from practical experiments will be available shortly; the gold and mercury are deposited together after extraction and the amalgam deposited is then treated for the gold in the usual way; the anode is in a separate compartment in a solution of an alkaline salt "so that the cyanide does not become decomposed;" the E. M. F. is 0.5 volt and the current density 0.06 ampere per square foot.

Effect of Great Current Strength on the Conductivity of Electrolytes. RICHARDS AND TROWBRIDGE. *Amer. Jour. of Sc.*, May.—In a recent paper they describe a method of determining a resistance by measuring the damping effect on electric oscillations; they applied this to electrolytes in order to determine if the intense current from the discharge of a large condenser is capable of causing any change in the condition of the electrolytes; they conclude that the conductivity of electrolytes is not essentially affected by great changes in current strength; in their other paper they showed that the conductivity of gases under the same conditions is very greatly affected.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Determining Alternating Current Curves. Marcher. *Elek. Zeit.*, April 15.—An illustrated description of a device which draws a continuous curve like an indicator diagram; it is based on the Joubert method. After describing the latter and several modifications of it, he gives an illustrated description of the one forming the subject of the paper; the curve is drawn on a revolving drum by means of a galvanometer or electrometer needle; the drum is revolved by being geared with a dynamo or to a synchronous motor; the essential feature is that a disc containing the contact revolves and that the brush making contact with it also revolves at a different rate, all the revolving parts including the drum being connected by gearing; the contact is therefore established at a series of successive points along the curve; the apparatus is transportable if provided with a synchronous motor. In conclusion the deflecting instrument is briefly discussed; when a ballistic galvanometer is used, the width of the brush introduces an error; when an electrometer is used the record is that of the voltage at the end of the contact but the electrometer is the better of the two; when the important point is to get the form of the curve without reference to the absolute values a galvanometer can be used, but when absolute values are necessary an electrometer should be used, the construction of which is still wanting.

Means of Producing a Constant Angular Velocity. Webster. *Amer. Jour. of Sc.*, May.—A brief description of a device used in physical measurements, such as the electrical determinations, in absolute measure, of the ohm; it consists essentially of an electric motor regulated by an intermittent current produced directly by a tuning fork; the continuous current motor has two armatures, one for the main driving current and the other, with collecting rings, for the auxiliary regulating current; the one he used had an output of one horse-power; the tuning fork is independently driven by a battery. He describes a convenient stroboscopic method for regulation by hand; the motor is first brought up to speed and the regulating current then thrown on. The variation from constancy of the angular velocity may be determined, but the mean velocity is constant to the limit of constancy of the frequency of the tuning fork, which is within one part in 20,000; the regulating current must be in the proper phase besides corresponding with the speed; a telephone may be connected across the brushes of the regulating armature and will produce a loud noise when synchronism fails. The results of a test in which some power was transmitted are given and show the method at its worst; the maximum variation from the mean was one part in 800; the method is therefore practical up to more than 1.5 horse-power and is of undoubted usefulness in absolute determinations or in the driving of telescopes or sirens. The method of breaking such large currents by a tuning fork is described in another paper by the same author, abstracted below.

Rapid Break for Large Currents. Webster. *Amer. Jour. of Sc.*, May.—An illustrated description of a device for breaking relatively large currents by means of a tuning fork, to be used where a regular break is necessary; the ordinary breaks used for induction coils would not answer for such currents. The principle of the device is to have a wire attached to the tuning fork to break the current on the surface of a continually flowing stream of mercury surrounded by flowing water; the jet is kept cold and continually presents a fresh surface of mercury, and the mercury is washed in flowing water and comes out perfectly clean, the oxide being carried off by the water; the mercury is made to circulate by means of an aspirating water pump which is described and illustrated; the apparatus was very satisfactory and showed that a current of 12 amperes could be carried for an hour without any adjustment; in one form of apparatus the mercury was raised by water, and in another by air pressure; in the former, a head of 2.5 meters of water and a flow of 0.3 gallon per minute carried a current of 20 amperes and was used with forks giving 50 to 100 breaks per second.

Sensitive Galvanometers. Mendenhall. *Rose Technic*, April.—A compilation, largely from the writings of Ayrton, Mather and Sumpner, concerning the best design for a galvanometer of extreme sensibility; he discusses the d'Arsonval and the Thomson types, concluding with a table compiled by the above-mentioned authors giving certain constants of a number of different galvanometers; a list of about a dozen papers with references concerning galvanometers is also given; the paper does not admit of being abstracted.

Water Rheostat. Elec. Jour., April 15.—A brief illustrated description of a simple system suggested by Bertin-Sans, in a French medical journal; a jar contains some pointed carbon electrodes pointing downward; a conducting liquid, such as water, is allowed to flow in through one stop-cock and out through another; by partially turning these stop-cocks it may be brought to any height and maintained there.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone Switchboard System.—Elek. Zeit., April 15.—A short editorial referring briefly to the systems at Worcester, Mass., St. Louis and Stockholm, which latter system is somewhat different from the other two; it involves three central stations, which are so connected that each attendant is permanently connected with each of the other stations where their lines pass each of the attendants, and when this line is in use all the attendants are notified of it by means of a small disc; this enables each attendant who desires such a connection to find a line which is not in use, thus facilitating the work.

Unit for Measuring Cable Speed.—Lond. *Elec.*, April 23.—An editorial mention of the suggestion of Raymond-Barker (see *Digest*, last week), in which it is thought that the unit suggested is a very rational and proper one, and the hope is expressed that it will be generally accepted; the custom of the Eastern Telegraph and other allied companies regarding working speeds is briefly referred to.

Trunk Telephones. Pierart. Lond. *Elec. Rev.*, April 23.—A continuation of the discussion (in French) with Gavey (see *Digest*, April 24). He thinks the second explanation of Gavey, like the first, explains nothing, and the arguments given appear to demonstrate the very contrary to that which he wants to prove.

Disc Microphone.—Elek. Zeit., April 15.—A brief illustrated description of one made by Stock; it consists essentially of a disc against which rest 12 carbon rings which are loosely pivoted eccentrically so as to bear lightly against the disc; it is very easily adjusted.

Electric Interlocking Railway Signals. Hollins. *Jour. Inst. Elec. Eng.*, April.—A reprint of the conclusion of the discussion of this paper, which was noticed in the *Digest*, February 20, March 6 and 27.

Modern Telephone Station. Kammeyer. *Elec. Rev.*, April 28.—An illustrated description of the central station in the western part of Chicago, for which it is claimed that it "undoubtedly is the most modern and perfectly equipped telephone station in the world to-day."

Madison Telephone Exchange.—Elec. Rev., April 28.—A brief illustrated description of this station.

Nickel Stress Telephone.—El'ty, April 28.—A reprint of the abstract noticed in the *Digest*, May 1.

Polarized vs. Non-Polarized Relays for Single Circuits. Finn. *Tel. Age*, April 16.—The first part of an article discussing the relative merits of the two systems.

Annual Report of Bell Company.—Elec. Rev., April 28.—A reprint of the annual report for the year 1896.

MISCELLANEOUS.

Diatrine.—Lond. *Elec.*, April 23.—A brief description of this insulating material invented by Dia; it is non-fibrous, containing neither rubber nor bitumen; it is not so elastic as vulcanized india-rubber or gutta-percha and is inferior in mechanical strength, but is absolutely waterproof, and its specific resistance is only slightly less than that of vulcanized rubber, its specific inductive capacity being considerably lower, although not quite so low as of impregnated fibre; it will resist high voltages without breaking down; it is wrapped around a cable in the form of a tape which is then highly heated, the copper being first covered with paper to protect it from the sulphur; it is also used for insulating transformers which are wound with cotton covered wire and then impregnated with this compound.

Converting Peat into Coal.—Elec. Tech., March 31.—The turf is placed into retorts lined with asbestos and containing a spiral of wire through which a current is passed, heating it sufficiently for converting the peat into coke, which requires 15 minutes in a retort having a capacity of 1300 liters; the amount of ash in this coke is only 3 per cent. and the calorific value of this coke is 7000 units, that is, as much as that of coal; it is easily lit and gives off an intense heat; it contains but little sulphur; it is claimed that it can be sold for 10 cents per hundred pounds; it appears that it is not yet being manufactured on a commercial scale.

Newcastle Exhibition.—Lond. *Elec. Rev.*, April 23.—A brief description of some of the electrical exhibits at this electrical and general exhibition.

Educational.—Elek. Zeit., April 15.—The programs of the lectures and instruction in electricity at a number of the institutions in Germany.

Biographical.—Elek. Zeit., April 15.—A short biographical notice of the late Heinrich von Stephan.

Smelting in the Electric Furnace. Heibling. *Eng. & Min. Jour.*, April 17, and *El'ty*, April 28; an abstract from *Genie Civil.* He experimented with the smelting of metallic ores, recognizing the fact that the slag must be made conductive, so as not to interfere with the current; by using a mixture of lime and carbon he obtained a slag which was a good conductor and at the same time the slag, which is a carbide of calcium, although impure, has a commercial value for the generation of acetylene; a part of the carbide takes up the oxygen of the ore while the other part combines with the lime and different contents of the ore, transforming them into carbides, which are conductors; the infusible portions of the ore are held in suspension while the metal settles into the bottom; in this way chrome-iron ore was treated with success.

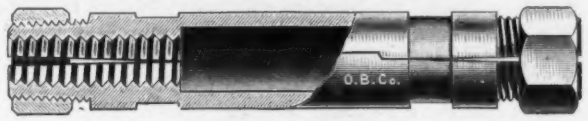
Magnetic Chuck.—Amer. Mach., April 29.—An illustrated description of a lathe chuck intended for bicycle parts, such as cups, cones, etc., while being ground after hardening; the special feature is the rapid mounting and attaching of the parts, as well as the absence of distortion due to the pressure of the jaws of the common chuck; the operations are performed very quickly and the lathe does not have to be stopped or even slackened; the gripping power is controlled at full speed by a foot lever switch.

Lighting and Extinguishing Gas Burners.—Prog. Age, April 15.—An illustrated description of the system used at Aix-le-Bains for street light-

ing; it has been in use for three months; in place of the valve there is a steel ball closing the end of the pipe at the bottom of the burner, which ball is raised; current is passed through a coil for one or two seconds; when a certain piece of steel is magnetized the gas supply is on, and when neutral it is off; the gas is lit either by a spark or by an incandescent wire.

A New Feed Wire Splicer.

The splicing of electric railway feed wires is at the best a difficult task, and any new means of facilitating and rendering such operations less troublesome are always hailed with satisfaction by railway constructors and managers.



FEED WIRE SPLICER.

The device illustrated herewith, which is made by the Ohio Brass Company, Mansfield, Ohio, has for its object this very purpose, and as it is rational in design and application, it will likely find a quick market. It affords a practical means of making a cheap, quick and effective splice in feeder wires, and in connection with larger gauges it offers special advantages.

The splicer is made in two parts, which are exact duplicates of each other, except that one is slotted to allow solder to be poured through it. The parts are dovetailed together when in position and held by two nuts threaded externally on their ends. The inside diameter of the central portion of the splicer is a trifle larger than the wire, which permits of the accumulation of a sufficient quantity of solder at that point to insure a perfect electrical and mechanical connection. The extremities of the splicer are tapered and slightly corrugated on the inside, and when the abutting ends of the wire are clamped and the nuts screwed tightly in place, they are held securely in position. The device, it is evident, can be used as a permanent or temporary connector, and it works equally well with solid or stranded conductors.

For hard drawn wire the splicer is slightly different in construction from that above described, which is intended for soft drawn copper wire. The greater tensile strength of the hard wire requires a stronger method of splicing, and to accomplish this the wires are headed on their ends by a special riveting tool before they are placed on the splicer. The inside of the splicer is so constructed that the heads seat themselves against a shoulder, which arrangement, together with the solder used, makes a joint the full tensile strength of the wire itself.

New Waterproof Socket.

WATERPROOF SOCKET.

A waterproof lamp-socket finds very extensive use, as there are many damp and wet situations where electric lamps are taken and used. There are many such sockets in the market, but the one illustrated herewith possesses some advantages over others of this class.

The Bryant Electric Company, Bridgeport, Conn., calls our attention to the important feature of this device as represented in the method of sealing in the wires, which renders the socket absolutely waterproof. Another important advantage is the length of the porcelain skirt at the bottom. Being of unusual length it fully covers the lamp base.

This style of socket is made for Thomson-Houston and Westinghouse bases, and is about to be placed upon the market by the Bryant Electric Company.

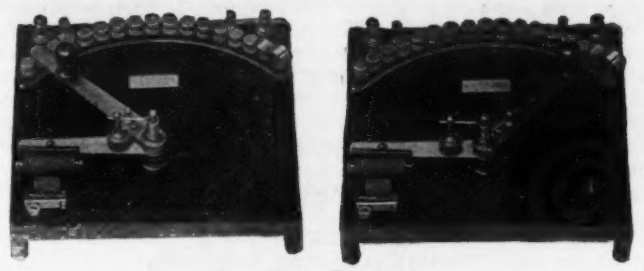
Universal Automatic Rheostat.

A new type of rheostat for automatically starting motors is being introduced to the trade by the Ward Leonard Electric Company, Hoboken, N. J., which device is said to represent the highest development in this particular line of apparatus. It is provided with "overload" and "no-voltage" release, and is guaranteed to protect the motor from all damage under all practical conditions so long as the automatic mechanism is not interfered with.

The "D. L." rheostat, as it is called, the letters signifying "double lever," possesses several features, among which may be enumerated the following:

It automatically opens the circuit when the E. M. F. (not current) of the supply circuit fails or falls greatly below the normal E. M. F.; it automatically opens the circuit when the current through the motor becomes excessively large; it is not affected under any conditions when the E. M. F. and current are kept within normal limits; it is impossible for the operator to send a damaging current through the motor by cutting out the rheostat resistance too rapidly; it is impossible to close the main line circuit upon the motor at rest, with all resistance cut out.

In this rheostat the troublesome features of other types of apparatus of



AUTOMATIC RHEOSTAT.

this class are overcome, as the light, quick-acting snap switch, moving through the air with a minimum inertia and friction, reduces all arcing to the lowest value. This apparatus is dependent only upon the voltage and horse-power of the motor, and any motor, however wound, can be operated with uniform results by its aid.

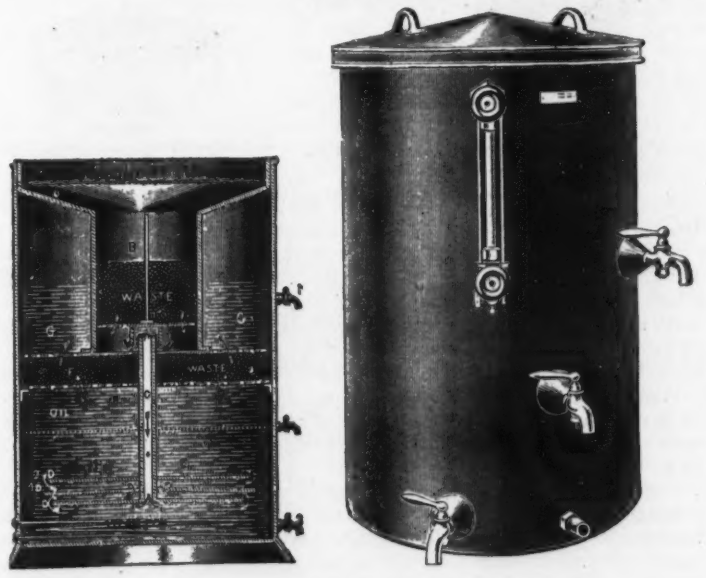
The fact that the rheostat has no solenoids, latches, triggers, weights, etc., enables it to be placed in any position, where it will work with equally satisfactory results.

Oil Filter.

The importance of using clean oil in the lubrication of machinery cannot be overestimated, and many devices have been produced for attaining this desirable condition in lubricants.

One of the best-known oil filters is the Cross oil filter, manufactured by the Burt Manufacturing Company, Akron, Ohio. These filters are made in various sizes, with capacities ranging from 3 to 120 gallons per day, and are constructed of iron, brass or nickel-plated copper.

The oil to be filtered is poured in the chamber *B* through the sieve on top. It then passes through the layer of waste which holds all of the heavier impurities contained in the oil, and then passes through the tube *C* and into the filter plate at the bottom. The water, however, tends to keep the oil in the tube, but the pressure of the oil in the upper chamber forces out the oil in the tube and spreads it over the filter plate in a very



OIL FILTER.

thin film, which exposes every particle of the oil to the action of the water contained in the lower part of the filter. The oil then flows upon the other two filter plates, on leaving which it is in a finely divided state of separation and thoroughly mixed with water, which cleanses it. The oil and water then separate by gravity, the water carrying with it all of the remaining impurities from the oil. The impurities settle in the lower chamber and can be drawn off through cock 3. The rising oil then filters through the layer of filtering material in the middle of the case and collects in the chamber G, where it can be drawn off thoroughly cleansed.

The water in the bottom chamber is kept warm by means of a steam pipe passing into and out of the receptacle.

The Burt Manufacturing Company has been making these filters for nearly seven years, and has shipped them to leading concerns all over the world.

First-Class Cheap Rosette Cut-Out.

The demand for a first-class rosette, cheap in price and easy of application, has led the Peru Electric Manufacturing Company, Peru, Ind., to produce the article illustrated herewith.

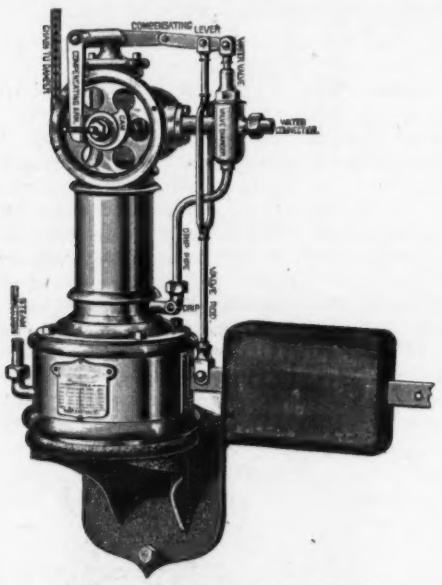
As will be seen, this rosette is of the simplest design, and the fact that it has few parts is one of its most valuable features. It is made of the best porcelain, such as the Peru Company use in the manufacture of its electrical specialties, the terminals being of solid, heavy brass. There is only one screw to tighten in order to hold the top, and the contact points are solid and secure.

This rosette can be used equally well for cleat or concealed wiring, the change being accomplished by simply changing the lugs, end for end.

On account of the simplicity of this article, its availability and its low price, it should meet with much favor in the trade.

Hydraulic Damper Regulator.

Damper regulators are to-day recognized as necessary adjuncts to all steam plants. Steam users who have thoroughly studied the various fuel saving appliances now on the market are the first to recognize the value of a well-proportioned and carefully made damper regulator. The leading steam engineers of to-day admit that the only suitable apparatus for the control of steam boilers is a cold water machine, *i. e.*, one operated by



Hydraulic Damper Regulator.

Rosette Cut-Out.

hydraulic pressure. The advantage of using water pressure is in the constant and non-variable movement which is obtained.

The Mason Damper Regulator, which is manufacture by the Mason Regulator Company, 6 and 8 Oliver Street, Boston, Mass., belongs to that class of regulators which are controlled by the variation of the boiler pressure, the motive power for opening or closing the damper being the water pressure, which can be taken from the street main or from the boiler itself, when there is no available street water pressure. Surprising results in the saving of fuel have been obtained through the use of the Mason regulator, to say nothing of what the machine accomplishes in the way of giving an even steam presure, presservation of boiler and grate bars and also as a faithful watch in preventing explosions.

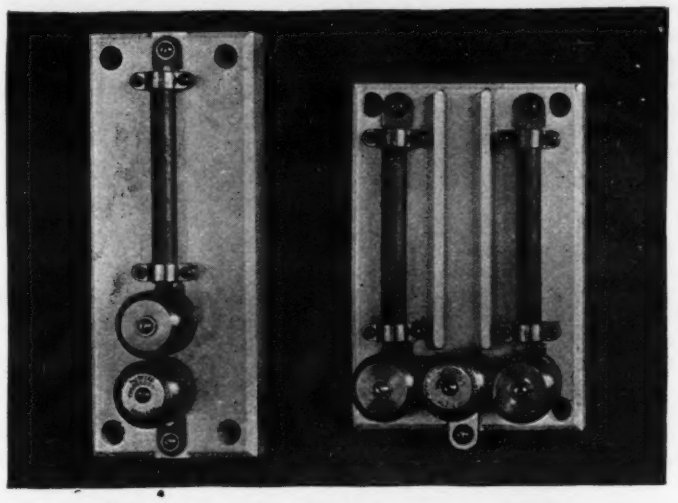
The main features in the Mason machine are its adaptability to high steam pressures, its simplicity and the excellence of material used and workmanship. One machine will as easily control a battery of boilers as a single boiler, and with a variation in steam pressure so small as not to be noticed on the steam gauge. This machine is made entirely of brass composition, highly polished, and is an ornament to any engine room.

New Lightning Arrester.

The first requisite for a lightning arrester for overhead wires supplying alternating current is that it shall permit the passage of high potential discharges and at the same time prevent the alternator current from following and maintaining an arc. The most ready way to accomplish this is to make the spark-gap in the arrester so long that the alternator will not maintain an arc across the gaps. A long gap would not, however, be effective in protecting electrical apparatus from high potential discharges, because, in order to afford protection, the arresters must be the weakest spot on the line.

It has been determined by records that arresters for use on such circuits should require a low potential to cause the current to pass across the spark-gaps, separating the line from the ground connection.

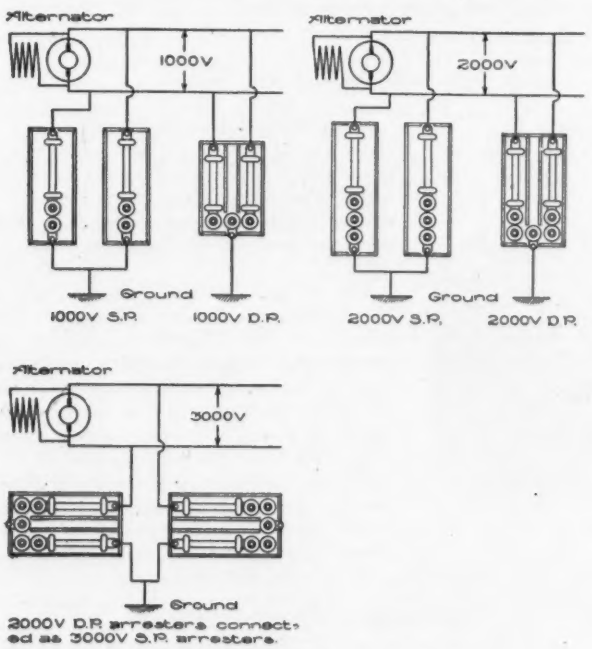
The Wirt alternating current short gap arresters have been especially designed to operate effectively with very small gap spaces. The arrester for 1,000 volt circuits has but one spark gap of one-thirty-third of an inch between two metal cylinders two inches in diameter and two inches long. One cylinder is connected to the overhead line and the other to the ground and a low non-inductive graphite resistance is placed in circuit. The com-



Alternating-Current Lightning Arrester.

bined action of the metal cylinders and non-inductive resistance prevents the heating of the cylinders when the lightning discharge passes across the gap making the gas which would enable the alternator to maintain the arc. The arc itself is extinguished by the reversal of the alternator current. This arrester is therefore not an arc rupturing device, but actually prevents the formation of an arc. The action being dependent upon the cooling effect of the large metal cylinders, which effect is increased by the introduction of a non-inductive resistance, and not upon any non-arcing property of the metal itself.

The arrester for 2,000 volt work has two gaps of approximately one-thirty-second of an inch each and a low non-inductive resistance. This arrester will not hold a short circuit when connected directly across a 2,400 volt



Connections of Arresters.

alternating current line, but will hold an arc when tested on a 500 volt continuous current line.

The Wirt arresters are designed for use on alternating current circuits at practically any potential, the standard list including an arrester for 15,000 volt lines. For circuits above 2,000 volts the standard 2,000 volt double-pole arrester has been adopted as a unit, several of these being connected in series for high potential work.

Arresters of this type have been adopted for the protection of the power line connecting Niagara Falls and Buffalo, at the power house of the Niagara Falls Power Company.

Arresters of this type are now standard with the General Electric Company for all alternating current work, and a large number are already in service protecting long distance transmission power lines having a working voltage as high as 15,000 volts.

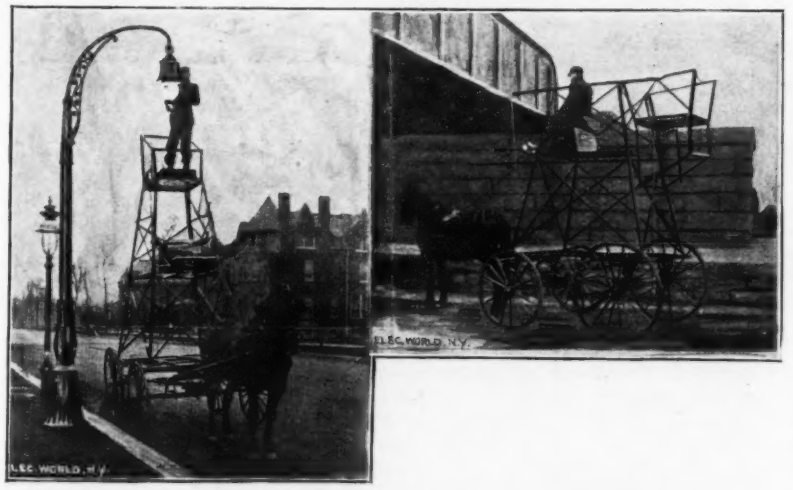
A Trimmers' Tower Wagon.

A very convenient form of tower wagon designed to facilitate the trimming and care of arc lamps has been recently introduced by the Studebaker Brothers Manufacturing Company, South Bend, Ind. The frame work of the tower is made of angle iron, which combines lightness and strength. Two wooden platforms are provided, the upper one for the trimmer to stand on, and the lower one to carry supplies. The tower is mounted on the spring supported running gear of the wagon, the springs being extra stiff to prevent oscillation.

A brake handle is provided at the upper level to enable the workman to set the brakes when on a grade and also to avoid the dangers resulting from any uneasiness of the horse.

It is stated that one trimmer, who acts as his own driver, can trim and clean 250 lamps a day by the use of this wagon. Under the old method, where the workman carries a ladder and kit, 60 lamps per day is all that he can attend to. By the aid of a wagon, therefore, one man can do the work of four in the old way.

The seat of the wagon (on the first platform) has a capacity for carrying 2,000 carbons, and a leather bag with a holding capacity of 200 carbons may



TOWER WAGON IN USE AND PASSING UNDER A BRIDGE.

be suspended from the top railing where it will be accessible by the workman. Lamps 19 feet from the ground may be trimmed from this wagon, which weighs, complete, about 975 pounds.

The wagon is also useful for other purposes, such as for hanging lamps, 15 or 20 of which can be carried at one time.

A very important feature of the wagon is that the upper portion may be turned back to admit of the passage of the wagon under bridges and similar structures. This feature is illustrated in the picture at the right; the other illustration represents a trimmer at work on a lamp.

A Portable Induction Coil for Röntgen Ray Work.

A portable induction coil for Röntgen ray work possesses obvious advantages, and Messrs. Willyoung & Co., Philadelphia, Pa., have met the demand for such apparatus in the coil shown herewith. This coil enables a surgeon or exhibitor to carry the apparatus from place to place with the least inconvenience.

The coil is equipped with the new "Ideal" automatic interrupter, reversing switch and adjustable discharge points, the entire instrument being mounted on a portable oak case with outside dimensions 14 x 12 x 6 1-2 inches, and weighing less than 25 pounds. This coil will give a spark of from 4 1-2 to 5 inches in length, which can readily be obtained from two cells of chloride accumulator. With this combination and a Bowdoin focus tube of proper exhaustion, practically any Röntgen ray work can be accomplished.

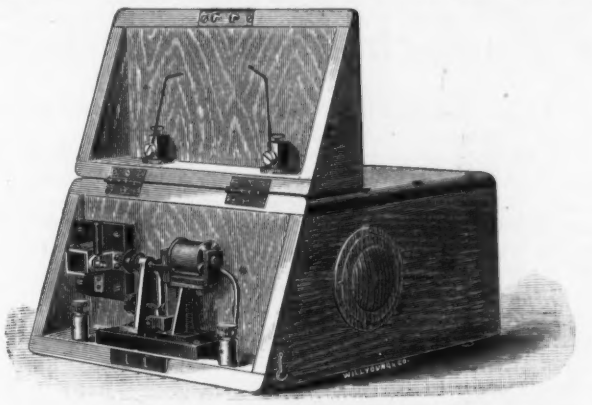
The outfit is recommended especially for "bedside" service and traveling exhibitors, but is as well adapted for office practice. Mr. James G. Biddle, 910 Drexel Building, Philadelphia, is sole agent for all apparatus manufactured by Willyoung & Co., and he will be glad to supply further particulars regarding this and other instruments handled by him.

Cashier's Electric Safety Cabinet.

The alarming frequency of hold-ups in banks, and the consequent jeopardy or sacrifice of life and loss of money, has turned the attention of electrical inventors to devise means of affording some practical protection under such circumstances through the instrumentality of electricity.

The Cashier's Electric Safety Cabinet Company, Mason and Belden Streets, Cleveland, Ohio, has brought out a seemingly successful method of getting the better of evil doers who enter banks for the purpose of robbery, and the patents on the same are said to be the first of the kind ever issued.

An illustration of the electric safety cabinet, both open and closed, is given herewith. The operation of the machine is both mechanical and elec-



PORTABLE INDUCTION COIL.

trical—mechanical during the routine of business; electrical when an attempted raid is made by robbers upon the bank. In the use of this cabinet the funds, which are usually placed in drawers and on top of counters, offering a tempting bait to robbers and sneak thieves, will be all placed inside of the cash receptacles, which are always locked by the service mechanism, except during the time the cashier desires access to the money in the ordinary course of business. By a quick pressure of the foot upon the foot plate the cabinet opens and remains open just so long as the cashier requires it to be so, and at the instant it is no longer required open the cabinet automatically closes and locks itself by a day locker, remaining locked until necessary to open it again. Wires are run from the base of the cabinet to various points of the bank, and push buttons are provided at every desk and all along the inside of the counters. In the event of a raid, the mere touching of one of the push buttons by the foot will cause the current to instantly operate the emergency mechanism, which locks the machine absolutely. It is then impossible for the burglar to gain access to the interior, neither can any one else open it, except through an instrumentality outside of the bank. At the instant the emergency locking apparatus is operated the electrical attachment disengages powerful machinery attached to and rings a large gong, the noise of which can be heard at a great distance, thus summoning help from every direction. The

CASHIER'S CABINET OPEN AND CLOSED.

emergency mechanism does not become operative, it will be understood, except in the case of an attempted raid. Ordinarily, the mechanical locking device is utilized, and its operation is entirely local.

Mr. P. F. King, the inventor of the screw door bank safes which, it is stated, have never been opened by burglars, is the inventor of this cabinet. It will, no doubt, be recognized as a very valuable and necessary protective device for large business houses, banks and other similar concerns that are liable to become the objects of raids on the part of evil doers.

The machine is made in three sizes, weighing from 400 to 700 pounds.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, May 3, 1897.

ELECTRICAL STOCKS.—There was no marked feature in this list last week, and no great changes are recorded. New York Edison advanced 1¼ points, and General Electric common also advanced about the same amount. Electric Storage Battery, both common and preferred, lost about 3 points each, and this in the face of the favorable financial report that was issued last week, and which is summarized elsewhere in this column. The Westinghouse issues were weaker.

TELEGRAPH AND TELEPHONE.—American Bell, as usual, lead the list in range of change, having advanced 2½ points last week. Commercial Cable, which usually varies 10 points at a jump, declined that amount from last quotations, and Western Union joined the list of declining stocks, dropping over 2 points.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	110	..
Edison Electric Ill., New York	100	107¼	109
Edison Electric Ill., Brooklyn	100	..	97
Edison Electric Ill., Boston	100	..	..
Edison Electric Ill., Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	16¾	17
Electric Storage, pref	100	18	19
General Electric	100	31¼	32
General Electric, pref	100	..	75
Westinghouse Consolidated, com	50	..	23
Westinghouse Consolidated, pref	50	49½	50¼
BONDS.			
Edison Electric Ill., New York, con. 5s	105	110½	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	96	..
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	223	224
American District Telegraph	100	29	39
American Telegraph and Cable	100	87	89
Central and South American Telegraph	100	124	127
Commercial Cables	100	150	..
Erie Telephone	100	63	64
New England Telephone	100	101½	102
Postal Telegraph Cable	100	96½	98
Western Union Telegraph	100	76¾	76⅞
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	19⅛	19⅜
Brooklyn Rapid Transit	..	20	21
Brooklyn Traction	100	..	14
Brooklyn Traction pref	100	46	48
Buffalo Street Railway	100	72	74
Cleveland Electric Railway	100	..	..
Columbus Street Railway	100	43	46
Hestonville	100	49	50
Hestonville, pref	..	..	62½
New Orleans Traction	100	6	8
New Orleans Traction, pref	100	25	30
North Shore Traction	100	19	21
North Shore Traction, pref	100	76	78
Rochester Street Railway	..	13	15
Steinway Railway	..	45	50
Union Railway (Huckleberry)	..	97	103
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	70½	71
West End, Boston, pref	100	91¼	92
Worcester Traction	100	16	18
Worcester Traction, pref	100	91	93
BONDS.			
Brooklyn Rapid Transit 5s, 1945	100	79½	..
Buffalo Street Railway 1st con. 5s	100	*106½	108½
Cleveland Electric Railway 1st mtge., 5s	100	103	105
*Columbus Street Railway 1st 5s	100	94	96
Rochester Street Railway 1st 5s	100	..	100
Union Railway (Huckleberry) 1st mtge. 5s	..	101½	106½
*Westchester Electric 1st mtge. 5s	100	100	103

*With accrued interest.

ELECTRIC TRACTIONS were quiet during the past week, and the changes were fractional in most instances. New Orleans Traction was about the strongest feature, both the common and preferred issues advancing considerably on light trading. The favorable report of the Brooklyn Heights Railway induced a good demand for that stock, and the price advanced considerably, owing to the unwillingness of holders to part with it. The balance of the list was quiet.

STORAGE BATTERY BUSINESS.—A statement issued by the Electric Storage Battery Company, Philadelphia, shows that during the year ending December 31, 1896, the gross sales were $646,318, and the total expenses $504,320, leaving a profit of $141,998. Add to this income from royalty and investments amounting to $6,801, and deducting interest on bonds, $13,737, leaves a net profit of $135,062.

EARNINGS.—The report of the Edison Electric Illuminating Company, of Brooklyn, for the month of March, shows gross earnings of $71,729, an increase of $4,889 as compared with March, 1896. Operating expenses, $37,500, an increase of $522. Net earnings, $34,229, an increase of $4,366. After adding earnings from other sources and deducting therefrom taxes, the net result for the month is $30,823, an increase of $3813. The Edison Electric Illuminating Company, of New York, in its report of operations during March, 1897, shows gross receipts of $207,870, an increase of $23,713 over the receipts in March, 1896; the net receipts were $94,418, an increase of $15,924. The gross earnings for the three months ending March were $660,973, an increase of $63,414, as compared with the first three months of 1896; the net receipts were $324,970, an increase of $46,185.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, May 6, 1897.

MR. TOWNSEND WOLCOTT, consulting electrician, has removed his office from 97 Nassau Street to Room 455 in the new Bowling Green Offices, 5-11 Broadway.

MESSRS. DYER & DRISCOLL, the well-known attorneys at law, who make a specialty of patents and patent causes, have removed their offices to the new Bank of Commerce Building, 31 Nassau Street.

MESSRS. JOHN A. MEAD & CO., manufacturers of coal-handling machinery, have moved from 1 Broadway to a large suite of offices in the Bowling Green Offices, 5-11 Broadway.

PERMANENT RECEIVER.—Justice Beach has appointed Mr. J. Sidney Ball permanent receiver for the Ball Electric Light Company, in the suit brought by Mr. Royal E. Ball. The receiver's bond has been fixed at $15,000.

AMONG NEW YORK'S VISITORS during the week were Mr. A. L. Daniels, of The H. B. Camp Company, Aultman, Ohio, and Mr. J. H. Shay, the Philadelphia representative of the Chas. Munson Belting Company, Chicago.

REMOVAL.—The New York agency of the Holtzer-Cabot Electric Company, Boston, has been removed next door to the old stand on Liberty Street. The new number is 112. Mr. David Chalmers, the New York representative, has secured very much larger quarters in the new than he had in the old place, and will be able to make a much more extensive display of his large line of goods.

NEW DIRECTORS OF THE NEW YORK TELEPHONE COMPANY.—The annual meeting of the stockholders of the New York Telephone Company was held at 15 Dey Street on May 4, at which the following named gentlemen were elected directors: Charles F. Cutler, John H. Cahill, Joseph P. Davis, Thomas T. Eckert, William H. Forbes, George J. Gould, Edward J. Hall, John E. Hudson, John Jameson, James Merrihew, Charles A. Tinker, John Van Horne and William H. Woolverton.

GOOD COUNSEL FARM, at White Plains, N. Y., conducted by the Sisters of the Divine Compassion, is to have a model little electrical plant. It will consist of two 25-kw direct-connected machines, manufactured by the Onondaga Dynamo Company, Syracuse, N. Y. The sale was made by Mr. W. L. Fairchild, the New York representative of the Onondaga Company. Mr. Fairchild has also recently sold to the Sterling Supply & Manufacturing Company, New York, a 25-hp Onondaga motor.

OUT OF TOWN VISITORS.—The following named gentlemen from out of town registered at the headquarters of the National Electric Light Association, 136 Liberty Street, during the ten days ending May 5: J. H. Bowker, Philadelphia, Pa.; James Clark, Plainfield, N. J.; Wilson Kistler, Lockhaven, Pa.; O. W. Ruggles, Chicago; L. A. Robinson, Pittsburg; A. J. Smith, Cleveland, B. F. Horner, Cleveland; F. J. Moore, Buffalo; Frank Van Dusen, Pittsburg; H. J. Gaukins, Detroit; Geo. W. Vallee, Philadelphia; J. R. Wood, Philadelphia; W. E. Davis, Montreal; D. B. Martin, Baltimore; Charles Schry-

ver, Baltimore; C. E. Lambert, Haverstraw, N. Y.; J. W. Packard, Warren, Ohio; W. H. Dearborn, Philadelphia; C. F. Munder, Springfield, Mass; James I. Ayer, Boston; A. M. Young, Waterbury, Conn.; J. H. Reid, Pittsburg; J. H. Fredericks, Lockhaven, Pa.; M. E. Baird, Windsor, Conn.; H. T. Paiste, Philadelphia, and W. E. Sharps, Philadelphia.

THE SUIT OF THE OKONITE COMPANY against Holmes, Booth & Haydens has been settled out of court. The Okonite Company complained that in June, 1895, it contracted with Holmes, Booth & Haydens for 300,000 pounds of copper at 12¼ cents, and that after delivering 50,509 pounds, Holmes, Booth & Haydens refused to furnish any more at that price. The Okonite Company, in September, 1895, purchased elsewhere the balance of the copper at 14 cents, and then sued for the difference, about $4500. Holmes, Booth & Haydens denied the contract, but it is understood has now paid the Okonite Company about $2800 for a settlement.

THE AMERICAN INSTITUTE.—The directors of the American Institute announce that the next fair will be held at Madison Square Garden, New York, from September 20 to November 4 next, a period of six weeks. Mr. Alfred Chasseaud has been chosen as managing director of the fair. Mr. Chasseaud is planning to amplify the departments which have become regular features of the American Institute fairs, and will inaugurate several new ones. There are likely to be innovations in the way of exhibits from foreign manufacturers. A special effort will be made to secure all possible illustrations of new machinery, inventions, industrial and chemical processes.

TELEPHONE MEETINGS.—The annual meeting of the New England Telephone & Telegraph Company was held on May 3 at No. 15 Dey Street, New York, and the following named directors were elected: Charles F. Ayer, John H. Cahill, Benjamin C. Dean, William H. Elliot, William H. Forbes, John E. Hudson, Henry S. Hyde, Albert O. Morgan, David B. Parker, Moses G. Parker, Stephen Salisbury, Thomas Sherwin. At a meeting of the new Board of Directors, held on the same day and at the same place, the following officers were elected: Thomas Sherwin, president; Henry S. Hyde, vice-president; William R. Driver, treasurer; Samuel W. Leedom, secretary; Jasper N. Keller, general manager. The annual meeting of the Northern New York Telephone Company was held on the same day and at the same place, and the following directors were elected: Benjamin F. Sargent, Chas. T. Crosby, John H. Cahill, Fred. C. Church, Thomas Sherwin, David B. Parker, Geo. A. Roper.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., May 4, 1897.

MR. GEO. T. MANSON, of the Okonite Company, was a welcome visitor to Boston this week.

A SWITCHBOARD FOR THE LOWELL TEXTILE SCHOOL.—The W. S. Hill Electric Company has secured the order for the switchboard for the new textile school at Lowell, Mass., which for dimensions and ornamentation will rank with others of this company's important installations.

A GOOD TRADE IN RÖNTGEN RAY APPARATUS.—The Swett & Lewis Co., successors to G. A. Frei & Co., Boston, is meeting with some very gratifying results in the sale of its static machine, focus tubes and fluoroscopes. A highly skilled glass blower is employed and tubes can be made to order in any desired shape. Besides making a large number of sales throughout the United States the company has just made shipments to New Zealand, as well as to other places abroad.

THE LATE MR. ORFORD.—The committee appointed by the Electric Potential has reported a set of appropriate resolutions on the death of Mr. John M. Orford, who was one of the most prominent members of the society, and assistant manager of the Boston Electric Light Company. The resolutions express the deep feelings of sorrow of the members over his death, and tender heartfelt sympathy to the family of the deceased. Messrs. William Brophy, Geo. B. Neal and Chas. B. Davis constituted the committee.

A PROSPEROUS ELECTRICAL COMPANY.—The Hawks Electric Company, Boston, continues to do a very nice business in the line of electrical construction. Among its recent contracts is one with the Weston Electric Light Company, Weston, Mass., for extension recently undertaken; a contract for installing a power and lighting plant in the new shops of the Dennison Manufacturing Company, So. Framingham, Mass.; a contract for installing a lighting plant in the new opera house, Portland, Me.; and also a large contract with the Central Maine General Hospital, Lewiston, Me,

THE FRANK RIDLON COMPANY, 180 Summer Street, Boston, which occupies a very prominent position in the repair of second-hand electrical apparatus, has just issued a special circular stating that hereafter Billings & Spencer drop-forged segments will be used in refilling all its railway commutators. The company also makes a specialty of assembled copper and mica segments, finished, bound and slotted, ready to be shipped to the central station and there put into the shell. Among the recent sales the Frank Ridlon Company reports the following: Princeton, Ind., and Fitchburg, Mass, each one 2,000 light G. E. alternator; New London, Conn., one 50 light and one 75 light T. H. arc dynamo; Groveton, N. H., one 650 light T. H. alternator, besides several motors ranging from 1 to 85 horse-power, and a large lot of transformers. The popularity of Frank Ridlon and the energy of E. W. Kellogg are certainly a happy combination for results.

REPORT OF THE WIRE DEPARTMENT.—The annual report of the wire department of the city of Boston for the year 1896-7 has just been issued. It contains some fifty pages of very interesting information. After describing in a general way the four divisions of the department, viz., the interior, overhead, dead wire and underground, the report takes up in detail the results accomplished by each one. Several views are given of tangled overhead construction, which is rapidly being removed by the overhead department. A greater portion of the report is devoted to the underground service. The various styles of conduit and cables are briefly described, and a complete summary is given of the installations and changes made by the various electric companies. Two very fine maps accompany the report. As a whole the report reflects great credit upon Commissioner Flood and the admitted efficiency and painstaking efforts of Captain Wm. Brophy, chief electrician of the department.

PHILADELPHIA NOTES.

Branch Office of THE ELECTRICAL WORLD,
929 Chestnut Street,
PHILADELPHIA, Pa., May 4, 1897.

THE WILKINSON MANUFACTURING COMPANY, Philadelphia, manufacturers of the well-known mechanical stoker, has just opened an office at 120 Liberty Street, New York City. Mr. M. H. Treadwell is manager in charge.

MR. JOHN L. HALL, formerly with the Electrical Maintenance Company, has connected himself with the Crocker-Wheeler Electric Company, 14 South Broad Street, Philadelphia.. Mr. Hall's contract permits him to operate in all the territory controlled by the Philadelphia office, and he is also Wilmington sales agent in charge of Delaware business.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., May 3, 1897.

NEW TROLLEY LINE PROPOSED.—It is probable that in the near future an electric trolley line will be built from Wellsville, N. Y., to Bolivar, over the abandoned roadbed of the B. E. & C. R. R. The passenger and freight traffic would be large. The entire length of the proposed line is about eighteen miles.

CONTEST OVER A RIGHT OF WAY.—Since the defeat of the bill fathered by Senator Lamy to prevent street railway tracks being laid on Louisiana Street, the people of Buffalo have been anticipating a fight between the Buffalo Traction Company and the Buffalo Railway Company for the right of way through the coveted street, which is the only available connecting link between two large proposed trolley systems. To-day Alderman Franklin introduced a resolution giving the right of way to the Traction Company. The resolution is called for hearing on June 1, and will probably be passed.

CONTEST OVER A FRANCHISE.—The Canadian Niagara Power Company has taken the first step to contest the franchise granted by the Dominion Government to the Canadian Power Company, which proposes to develop power in the Niagara and Welland Rivers. The case will probably be finally carried to the Privy Council of England; and an order passed by the Provincial Executive Council in Toronto last week referring the question to the Court of Appeals begins a litigation which will involve millions of dollars. The Canadian Niagara Power Company bases its claim to the rights of an exclusive franchise on an agreement made between it and the Park Commissioners providing that no other company shall use the waterways of the Niagara River within the limits of the park so long as the agreement continues in force. In view of this it is claimed that the Dominion Government had no right to grant the Canadian Power Company its franchise.

PITTSBURG NOTES.

PITTSBURG, Pa., May 3, 1897.

A VISIT FROM MR. EDISON.—Mr. Thomas A. Edison was a Pittsburg visitor on Thursday last. In company with Mr. James F. Cummings, of Detroit, he visited the Carnegie Steel Company's Homestead mill, and the works of the National Tube Company at McKeesport. The object of the trip was not made known to the public.

ELECTRIC LIGHT PLANT AT BEAVER.—At a Borough Council meeting, held at Beaver, Pa., on April 27, it was resolved to have an election by the citizens to decide whether bonds shall be issued to pay for an electric light plant, and the borough attorney was instructed to draw up the necessary papers ordering an election. It is estimated that the plant required will cost about $20,000.

THE HOME TELEPHONE COMPANY has let the contract for all of its construction work to E. C. Phelps & Co., Baltimore, Md. Work will begin at once, and the Home Company has filed with City Controller a bond for $25,000, binding itself to begin work this month, and to complete it within the time specified in the ordinance granting it rights of way. A building on Grant Street has been leased for the central exchange, and quarters in East Liberty and Lawrenceville have been secured for branch offices. It is estimated that 200,000 feet of conduit will be required for the underground work in the downtown district. The company must have at least 1,000 telephones in operation by May 1, 1898, and 1,000 more each year for three years. It claims to have nearly 6,000 subscribers in Pittsburg and Allegheny.

ANOTHER NEW TELEPHONE COMPANY.—Nearly two years ago a company was chartered under the name of The East Pittsburg Telegraph & Messenger Service Company. An ordinance was secured from Pittsburg Councils granting rights of way and franchises for telephone service. No further move was made by the company until a few days ago, when it issued a circular stating that it will be ready for business upon the passage of an ordinance now pending in Allegheny City. The public is asked to sign contracts for telephone service for a period of three years, at the rate of $3 per month for business houses and $2 per month for residences. No names are given in the circular, and some of the original incorporators of the organization disclaim any present connection with the enterprise. The rates asked are even lower than those proposed by the Home Telephone Company.

Cleveland Notes.

CLEVELAND, Ohio, May 3, 1897.

MARCH EARNINGS.—The earnings for the Cleveland Electric Railway Company for March were $3989 greater than for the same month in 1896, and $21,748 more than in March, 1895. The total earnings for the first three months this year fell $700 below the earnings during the same period of 1896.

PROPOSED ELECTRIC RAILWAY.—It is reported that an electric railway may soon be built between Canton, Ohio, and Alliance, Ohio. The line would take in numerous towns, and, it is thought by those interested, would pay a handsome profit. Cleveland capitalists are interested in the enterprise.

FRANCHISE GRANTED.—At the last meeting of the County Commissioners held at Painesville, Ohio, the Painesville & Fairport Electric Street Railroad Company was granted a franchise over the county highway between Painesville and the harbor. The road will be constructed with all possible speed.

THE CLEVELAND & CHAGRIN FALLS ELECTRIC RAILWAY.—This company opened for business on May 1. Cars will run at intervals of an hour and a half, from 6:30 a. m. to 8:30 p. m. The present city terminus is at the end of the Kinsman line, but cars will be running to the Public Square within the next week.

FRANCHISE AT ASHLAND, OHIO.—Messrs. G. A. Ullman and J. R. Swartz, representing a company of Ashland capitalists, applied to the Council for a franchise to run an electric railway through fourteen streets of the town. The Council tabled the petition. The company was granted a franchise a year ago to run a line from Londonville, north through this county, and connect with Cleveland.

SUBURBAN RAILROADS.—The suburban electric roads centering in Cleveland are making preparations for a largely increased traffic during the summer by revising their time table. The new schedules will go into effect May 15. In the meantime several new switches will be provided, and in the case of the Cleveland, Painesville & Eastern Railroad, it is found necessary to add to the present capacity of its power house a 400-hp generator. It is now running two 266-hp generators. This company has just purchased a very handsome grove, situated on the line, which it is proposed to convert into a first-class picnic resort.

Chicago Notes.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., May 3, 1897.

IN NEW QUARTERS.—The Chicago Insulating Wire Company has moved into nice quarters at 152-154 Lake Street. The new offices are very commodious and especially adapted to the rapid and systematic transaction of its large and growing business.

MR. ALEXANDER CHURCHWARD, electrical expert of the Excelsior Electric Company, New York, was in Chicago during the week. He reports business improving very much. It is stated that Mr. Churchward has been retained as consulting engineer for a new electrical power-transmission scheme. In conjunction with Major A. J. Randolph, the Excelsior Electric Company's Western manager, he has recently closed some large contracts. His stay in the West will be quite prolonged.

THE SWARTS METAL REFINING COMPANY, Chicago, has moved to more spacious quarters at 20 North Desplaines Street, corner Eagle, where it will enjoy much better facilities for handling larger quantities of metal. The company has customers in every State of the Union, and a good export trade. It carries on a business as manufacturers, jobbers and exporters of metals, including high-grade babbitt, solder, spelter, ingot copper, pig lead, pig tin, old gold, platinum, silver, nickel, etc.

PROF. JOHN P. BARRETT has been asked by Mayor Harrison to resign his position as city electrician and superintendent of telegraphs of the city of Chicago, and his resignation is in the Mayor's hands. Professor Barrett's tenure of office has extended through practically the whole time in which electricity has been applied to municipal purposes. He first entered the department in 1862, but it was not until 1876 that he was appointed superintendent of the fire-alarm telegraph. In 1880 the police-alarm signal service was added to the fire alarm, and in 1884 electric light inspection was made part of the duties of the department. It was not until 1887 that the electric lighting of the streets came under his charge. During the World's Fair Professor Barrett was selected to take charge of the electrical department. His service in the city departments included the installation of a patrol-wagon system, which is his own invention, and fire-alarm telegraph appliances, many of which are also due to his inventive ability. While there has been within the last few years some criticism of Professor Barrett's methods in office, it is claimed by his friends that the reason for his resignation is that both the new Mayor and Professor Barrett believe thirty-five years to be long enough for one man to hold a city office. It is said to be not unlikely that he may be reappointed to the position if a suitable successor is not found. Should his connection with the city service be permanently suspended, it is likely that Professor Barrett will retire upon his pension and no longer engage in active electrical pursuits.

General News.

New Incorporations.

THE TWIN CITY TELEPHONE EXCHANGE ASSOCIATION, Minneapolis, Minn., has been formed by J. E. Keelyn, of Chicago; T. A. Potter, of Britt, Iowa, and others.

THE SUBURBAN ELECTRIC LIGHT COMPANY, Hempstead, N. Y., has been formed with a capital stock of $25,000. The directors are Olive M. Chace and Frank M. Frary, of Brooklyn, and Franklin H. Corwin, of Woodhaven.

THE IDEAL ELECTRIC MANUFACTURING COMPANY, Tucson, Ariz., has been formed with a capital stock of $150,000, by E. F. Cowley, F. E. Wolf and F. H. Steinacker.

THE CENTRAL WISCONSIN TELEPHONE COMPANY, Black River Falls, Wis., has been organized by A. S. Trow, H. A. Bright, E. A. Miller, J. B. Miller and B. L. Van Gorder.

THE COLES COUNTY TELEPHONE COMPANY, Mattoon, Ill., has been incorporated with a capital stock of $12,000. The incorporators are L. A. Lumpkin, W. C. Lumpkin and John W. Gay.

THE NORTH BEACH ELECTRIC LIGHT & POWER COMPANY, Newtown, N. Y., has been incorporated with a capital stock of $10,000. The incorporators are Michael Seitz, Louis Braun and Joseph Bill, of Brooklyn.

THE URBANA & CHAMPAIGN RAILWAY, GAS & ELECTRIC COMPANY, Champaign, Ill., has been incorporated with a capital stock of $250,000, to operate electric railways and gas works, etc. Among those interested are Benjamin F. Harris and Henry M. Harris.

THE HUDSON ELECTRIC RAILWAY COMPANY, Hudson, N. Y., has been incorporated by William H. Lamb, R. Raney, Peoni S. Johnson and others, to operate the road of the Hudson Electric Railway Company, which was sold under foreclosure. The capital stock of the new company is $50,000.

THE BUFFALO & DEPEW RAILWAY COMPANY, Buffalo, N. Y., has been organized with a capital stock of $100,000, to build an electric road seven and one-half miles in length. The directors are William B. Cutter, Augustin Smith, George A. Ricker, John H. Baker, Herbert P. Bissell, J. Henry Metcalf, George C. Riley, James Murphy and Frederick M. Turner, all of Buffalo.

THE OCEAN ELECTRIC RAILWAY COMPANY OF QUEENS COUNTY has been incorporated at Albany, N. Y., with a capital stock of $50,000. The incorporators are Daniel F. Lewis, Louis E. Robert and Henry R. Van Keuren, of Brooklyn; Samuel B. Lawrence, John B. Summerfield, William Chesebrough, Jr., Henry M. Haviland, Francis P. Lowery and Armitage Matthews, of New York City.

The Telegraph and Telephone.

BLACK RIVER FALLS, WIS.—The Wisconsin Telephone Company has been granted a fifty-year franchise by this city.

PLYMOUTH, WIS.—The construction of a telephone line between this city and Johnsonville will be commenced in a few days.

BUCYRUS, OHIO.—A franchise has been granted to the Bucyrus Telephone Company, which is composed entirely of Bucyrus citizens.

LOGAN, OHIO.—Mr. L. B. Engle, of Nelsonville, Athens County, Ohio, has been granted a franchise to establish a telephone exchange in this city.

NASHVILLE, TENN.—The Alabama-Georgia Long-Distance Telephone Company has commenced work in the extension of its line to Collinsville, Ft. Payne, Ashville and Rome.

JACKSON, MICH.—In view of the fact that a new telephone company is getting ready to start business in this city, the Bell Telephone Company has reduced its rates about 25 per cent.

STILLWATER, MINN.—A franchise has been granted by the City Council to the American Telephone & Telegraph Company to maintain and operate lines in this city for a period of twenty-five years.

CRESTLINE, OHIO.—Franchises have been granted to two telephone companies, one the Central Union, and the other a local concern, and it is expected that some lively work will be done to get the business in this place.

GOSHEN, IND.—A number of prominent citizens of this city are interesting themselves in the new telephone project. It is proposed to establish communication with Elkhart, where there is already a local independent telephone company in successful operation.

WABASH, IND.—While working in the fire tower in the exchange of the Home Telephone Company, a plumber accidentally fired the woodwork. All the connections were burned, and the exchange was greatly damaged by water. The loss is covered by insurance.

MINNEAPOLIS, MINN.—The Committee on Gas, which has been considering a municipal lighting-plant scheme, has decided to report unfavorably on the resolution referred to it. The committee states that the luxury of municipal ownership would be too costly.

BENTON HARBOR, MICH.—A new telephone company has been formed in this city to compete with the Bell Telephone Company, and it is stated that it has secured 260 subscribers. It will offer a rate of $18 a year, and it is stated that the Bell Company will make a fight.

GRAND RAPIDS, MICH.—The Citizens Telephone Company claims that it has 1837 instruments in use against the Bell Company's 839, an excess of independent 'phones of 998. The Citizens' Company states that it has not lost a single subscriber on account of the free service of the Bell Company.

WAYNESFIELD, OHIO.—Mr. F. J. Maisen, of Wapakoneta, Ohio, is actively engaged in securing subscriptions for a new telephone line from this city to St. Johns and other places in this localtiy. At the next meeting of the Council an ordinance will be passed giving the company the right to erect lines and operate an exchange.

SAGINAW, MICH.—The Valley Telephone Company has been incorporated in this city to construct and operate a telephone system in Saginaw, Bay City and West Bay City and the surrounding country. It is proposed to make the company a mutual concern, so that each telephone user will be a stockholder in the company as well. The company has a capital of $300,000, and claims to

have secured 1,000 telephone contracts in the three cities named, and as soon as franchises have been granted in these places, construction work will be commenced. The names of the officers are: President, J. L. Jackson; vice-president, J. E. Davidson; secretary, S. G. Higgins; treasurer, Orrin Bump; managing director, W. H. Gilbert.

CADILLAC, MICH.—The telephone line of the Citizens' Mutual Telephone Company is rapidly advancing toward this city from Grand Rapids. It is expected that the line will be completed as far north as Cadillac by May 10. Telephone service over the Citizens' line is now in operation between Reed City and Evart, and a number of places in the southern part of the State.

NEW YORK, N. Y.—The Mercantile Trust Company, New York, has invited proposals for the sale to it on July 1, next, of bonds secured by a mortgage executed in 1888, by the Metropolitan Telephone & Telegraph Company, at a price satisfactory to the New York Telephone Company, which succeeded the Metropolitan Company. The rate is fixed at not exceeding par and 10 per centum premium, and the amount shall not exceed $12,568.35.

ORRVILLE, OHIO.—There is some talk of establishing a telephone exchange in this place, and extending the line of the Millersburg Telephone Company to this city. On the completion of these improvements connections will be made with towns in this locality. The Farmers' Telephone Company has completed the extension of its lines to Loudonville, Widowsville and other places, affording direct communication between the farmers and several towns, Perrysville being the central office.

BOSTON, MASS.—The annual report of the New England Telephone & Telegraph Company for the year ending December 31, last, was issued on May 1. It shows gross receipts, $2,780,652; expenses, $2,175,717; net, $604,934; dividends, $508,180; surplus, $96,754. A substantial increase in the number of subscribers is recorded. During the past ten years the number of exchange stations has increased from 13,525 to 29,484; private line contracts from 2680 to 5454; mileage of exchange wire from 12,303 to 60,908 miles, and toll line wire from 3092 to 20,801 miles. The number of exchange connections has increased in that time from 18,400,000 to 66,800,000, and the toll line messages from 444,700 to 3,029,000. During 1896 the amount expended for new construction was $489,048. Attention is called to the fact that in order to maintain a telephone plant at its highest efficiency one-tenth of the plant must be replaced yearly. The underground system in the city of Boston extends through 229,000 feet, about forty-three miles of streets, the total length of duct being 1,562,000 feet, or 296 miles. The bonded debt of the company at the close of the year was $3,309,000—$2,459,000 at 6 per cent. and $850,000 at 5 per cent.

ELECTRIC LIGHT AND POWER.

FOND DU LAC, WIS.—An ordinance has been granted to R. F. Allen to operate an electric plant in the town.

NORRISTOWN, PA.—The question of issuing a loan of $200,000 for the purpose of erecting an electric light plant is being agitated.

PASADENA, CAL.—The electric light plant in this place has been sold to the Reorganization Committee of the Pasadena & Los Angeles Railway Company.

DES MOINES, IOWA.—The City Council has resolved to call a special election on May 17 to pass upon the question of building a municipal electric light plant.

WALNUT, ILL.—Mr. W. B. Milliken has been granted a franchise to establish and operate an electric light plant in this place. Further information can be obtained by adressing J. I. Kelly, the village clerk.

NEWPORT, IND.—Mr. William Rainby, chairman of the Electric Light Committee of this place, desires to communicate with responsible parties, with a view to the installation of an electric light plant in this city.

FLUSHING, N. Y.—The Flushing Electric Light & Power Company has decided to erect a new power house in this city at a cost of about $60,000, in order to meet the increased demands for light and power. The company, it is stated, will invest about $40,000 more for other improvements.

BROOKLYN, N. Y.—The Edison Electric Company will begin work shortly on another part of its new plant at Bay Ridge. The new structure will consist of a one-story brick power house, and will cost $125,000, and will be erected on the south side of Sixty-Sixth Street, west of Narrows Avenue.

WALTHAM, MASS.—The electric light meet of the Bostonian Cycle Club will be held here on the evening of May 19. Bicycle racing will be held by electric light, and several races will be run by well-known professionals and amateurs. There will be several meets of this character during the season.

LANSING, MICH.—The State Labor Bureau is investigating the gas, water and electric plants in Michigan cities. The work of the committee so far shows that of the sixty-nine electric light plants in the State twenty-two are owned by the cities, thirty-eight by corporations, and nine by private individuals.

NIAGARA FALLS, N. Y.—Work has commenced on the power plant of the Niagara Falls Power Company on the Canadian side of the river. It will be similar to the one on the American side. The Power Company has been paying $25,000 a year to the Ontario Government for the exclusive right to build this plant. The Ontario Government declined to renew the option unless work was commenced at once, and in order to hold the franchise the company decided to establish the plant on Canadian territory.

THE ELECTRIC RAILWAY.

COLUMBUS, OHIO.—The Brownell Car Company has brought suit against the Columbus Central Street Railway Company to recover $20,500, the aggregate of eight notes signed by Mr. John J. Shipherd, as president. The Organization Committee of the road, it is stated, has failed to accomplish the purpose for which it was created, and the road will be sold in foreclosure proceedings.

WARSAW, IND.—A company is being organized to build an electric road between Warsaw and Winona Park.

GREENSBURG, PA.—The Irwin Council has granted the right of way to the Greensburg, Jeanette & Pittsburg Electric Railway.

SCRANTON, PA.—Bernville citizens are contemplating constructing a railway between this place and Reading, a distance of fifteen miles.

TUXEDO PARK, N. J.—The movement is on foot to build an electric road from Paterson to Tuxedo Park, and eventually to extend it to Monroe.

FITCHBURG, MASS.—Hon. F. S. Coolidge, president of the Gardner, Westminster & Fitchburg Street Railway Company, states that the electric road will be built this summer.

MERIDEN, CONN.—The Board of Trade of Meriden held a meeting to discuss with the citizens of Meriden the most favorable way of extending a trolley road from Southington to Meriden.

NEW YORK, N. Y.—Architect A. V. Porter, 621 Broadway, has prepared plans for a three-story brick car and power house for the Metropolitan Street Railway Company, to cost $200,000.

EASTON, MASS.—The selectmen of Easton have granted a franchise to the Mansfield & Easton Street Railway Company. The road will be run as a connecting link between Brockton and Providence.

DOYLESTOWN, PA.—The prospects for a trolley road from Doylestown to Willow Grove are brighter than they ever were before, and it is expected before long that the road will be in the course of construction.

ATLANTIC HIGHLANDS, N. J.—A franchise was granted to the Atlantic Highlands, Red Bank & Long Branch Electric Railway Company to construct and maintain a double-track trolley road from Long Branch City to Long Branch Avenue, north of Broadway.

CLEVELAND, OHIO.—It is reported that electricity will be substituted for steam in the propulsion of cars on the Cleveland, Canton & Southern Railroad. The competition of electric suburban roads, it is said, has compelled the company to look into the subject for the sake of protecting its property and business. The Cleveland & Chagrin Falls electric line will, it is thought, deprive the Cleveland, Canton & Southern Railroad Company of a great deal of its business, unless it adopts the more modern method of transportation for the handling of suburban business.

PERSONAL NOTES.

MR. M. M. HAYDEN, formerly connected with the National Carbon Company, Cleveland, Ohio, has accepted the management of the Globe Carbon Company, Ravenna, Ohio.

MR. H. B. COX of London, England, inventor of the Cox thermo-electric generator, has just arrived in this country, where he will remain for a short time. The object of his visit is said to be the establishing of an agency in this country for the handling of his generators. Mr. Cox's headquarters during his stay here will be at 126 Liberty Street, New York City.

MR. CHARLES J. GLIDDEN, vice-president of the Erie Telegraph & Telephone Company, with headquarters at Lowell, Mass., is a pioneer in the telephone field, and has done much to extend the usefulness of that invention. As manager of the Manchester office of the Atlantic & Pacific Telegraph Company in the Winter of 1876, he arranged a test of the telephone over the wires of the company from Manchester to Boston. Prof. Bell had an audience in Music Hall in Boston, and the late Prof. Gower had an audience in Smyth's Hall in Manchester. The test was successful. Soon after this Mr. Glidden commenced building private telephone lines for the old New England Company, which was absorbed by the American Bell Telephone Company, and in 1877 commenced the canvassing for subscribers for the Lowell, Mass., telephone exchange. Mr. Glidden built the first toll line from Lowell to Boston, and was treasurer of the famous Lowell telephone syndicate that at one time controlled one-sixth of the local telephone business of the United States. In 1883 the territory under the syndicate's management operated 25,000 subscribers. Now in the same territory there are nearly 60,000 subscribers, with thousands of miles of toll lines. Since 1883 Mr. Glidden has given his time exclusively to the Erie Company, which numbers 22,000 subscribers, operates 12,000 miles of long-distance lines and 50,000 miles of wire in the States of Minnesota, North Dakota, South Dakota, Arkansas and Texas, and the city of Cleveland, Ohio. The Erie Company is said to have the best system of toll lines of any company in the United States. Its longest line in the Northwest is 750 miles, and in the Southwest by the first of October it will have a circuit 812 miles long from Helena, Ark., to Galveston, Texas, via Dallas. At Helena connection is made with the Cumberland Company to Memphis and there with the long distance lines all over the country. Every day at 4 p. m. a long-distance telephone circuit is arranged with the general manager's office of the company at Cleveland, which travels via New York, a distance of about 900 miles, and all the correspondence between the executive office and that of the general manager exchanged, thereby obviating the use of the mails, and saving time between the two offices. An average of forty communications are transmitted daily. Mr. Glidden was one of the organizers of the Traders' National Bank in Lowell; in 1892 he was elected its president, which office he now holds.

CHARLES J. GLIDDEN.

Obituary Notes.

MR. T. C. PRICE, manager of the Electrical Supply Company, City of Mexico, Mexico, died of typhus fever on March 31, last. Mr. Price was a comparatively newcomer in the electrical field, but during his short experience he made a large number of friends.

MR. M. C. BRISTOL, well-known among the telegraphic profession and superintendent of construction of the Western division of the Western Union Telegraph Company, died at his home in Chicago, on April 30, of typhoid malarial fever, with which he had been ill for two months. Mr. Bristol was a native of New York State, and was born in 1842. He entered the service of the Western Union Company in 1861, and in 1862 joined the United States military telegraph corps. At the expiration of his army service he returned to the Western Union Company, with which he remained until his death.

MR. FRANKLIN G. BEACH, general manager of the Central Union Telephone Company, died at his home in Evanston, Ill., on April 28. Mr. Beach was born in Monroe, Mich., fifty-five years ago, and began his business career as a telegraph operator. He was superintendent of the old Atlantic & Pacific Telegraph Company twenty-five years ago, and afterward became interested in the telephone, with which industry he remained identified up to the time of his death. He was of a quiet and unassuming personality, but intensely energetic and well-liked by all associated and acquainted with him. Mr. Beach was a member of various prominent clubs in Evanston, also of the Lotus Club, New York. He had been ill for several weeks with a complication of diseases, which ended in a cerebral affection, and finally death ensued.

Trade and Industrial Notes.

MESSRS. WIEDERHOLD & STOECKEL, 257 Front Street, New York, are meeting with success, judging from the sales of their high-grade insulating compositions.

MESSRS. E. B. LATHAM & CO., 136 Liberty Street, New York, are busy filling orders for the Tuerk alternating-current ceiling fan, for the sale of which they are the general agents.

A POPULAR ARC LAMP.—The Puritan Electric Company, New York, is enjoying a good trade in its long-burning arc lamps, and the fact that it is receiving duplicate orders for them indicates that the lamp is giving satisfaction.

THE KESTER ELECTRIC MANUFACTURING COMPANY, Buffalo, N. Y., informs us that it is manufacturing a high-grade cycle. Mr. Kester will be glad to furnish any of his electrical friends with a wheel at "sub-basement" prices.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, 32 Cortlandt Street, New York, purchased over two-thirds of the stock of electrical and railway supplies of the late firm of The E. S. Greeley & Co., which was sold at auction on April 19 last.

THE H. W. JOHNS MANUFACTURING COMPANY, 100 William Street, New York, has just issued a neat pamphlet describing and illustrating its various electrical manufactures, including molded mica goods, vulcabeston goods, electric car heaters, electrotherms, etc.

MR. H. J. GORKE, 120 "The Bastable," Syracuse, N. Y., general contractor for electric light and power machinery, has recently finished installing a complete lighting plant in G. Thos. Ryan's ale brewery, Syracuse, N. Y., consisting of a 15-kw Eddy multipolar, belted, type generator.

A DIVIDEND OF 3 PER CENT IN THREE MONTHS.—The regular quarterly meeting of the Board of Directors of the Davis & Egan Machine Tool Company, Cincinnati, Ohio, was held on April 27, and a dividend of 3 per cent. declared out of the earnings for the past three months.

MR. CHARLES WIRT, electrical engineer, 1028 Filbert Street, Philadelphia, has just issued a circular relating to the Wirt dynamo brush, which is so well known and extensively used. It includes an excellent article by Mr. Wirt on the Care of Commutators, which will be found very valuable to those having the practical care of electrical machinery.

MR. MAX MAYER, formerly connected with the Saruya Engineering Company, has opened a general electrical engineering establishment, with offices at 943 Third Avenue, New York. The firm will be known as Mayer & Co. This concern has recently completed the electric lighting system upon the steam yacht "Rival," owned by Gen. C. C. Dodge.

THE HAYDEN & DERBY MANUFACTURING COMPANY, 111 Liberty Street, New York, has issued an illustrated catalogue of Metropolitan injectors and H-D injectors. The Metropolitan injectors are used in the largest electric light and power plants, factories, steamships, etc., and they received a diploma, medal and highest award at the World's Columbian Exposition.

THE CARLISLE & FINCH COMPANY, 828-830 West Sixth Street, Cincinnati, Ohio, has recently been incorporated under the laws of the State of Ohio, with a capital stock of $10,000. It will continue in business at the same location, and deal in general electrical machinery, etc. It is also making a specialty of high-grade search lights, and a full line of ingenious electrical toys and other novelties.

MESSRS. BRUNT & THOMPSON, East Liverpool, Ohio, report a large and increasing demand for their B. & T. regulating socket. This socket, as is well known, regulates on a 110 circuit, direct or alternating current, from 16 to 2 candle-power, and it is claimed to be the first and only regulating socket of its kind ever produced. Supply men throughout the country are generally enthusiastic over the demand for this socket.

LA COMPAGNIE D'ELECTRICITE DE NANCY (France), which has a large electric lighting and motor system in that city, is about to extend its lines. It is now installing two sets of generating machinery, with a capacity of 400 kilowatts each, for continuous current. The construction of this plant is in the hands of the well-known house of Fabius Henrion, of Nancy.

THE CAMPBELL & ZELL COMPANY, Baltimore, Md., maker of the well-known Zell boilers, has just received a contract from the Metropolitan Railroad Company, Washington, D. C., for 1204-hp Zell improved water tube safety boilers making the fifth order from that company. This makes an aggregate of nearly 3000-hp of Zell boilers now in use in the various power houses in Washington.

ONE WEEK'S ENGINE BUSINESS.—The Ball & Wood Company, New York, during the past week made several shipments of engines, including the following: One 150-hp standard simple engine to the Ogdensburg Electric Light Company, Ogdensburg, N. Y.; one 450-hp vertical compound engine and one 200-hp tandem-compound engine to New York for export, and one 150-hp simple engine to David S. Brown & Co., New York City.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is putting on the market a line of electric tailoring and laundry irons, for which many claims are made. It goes without saying that the best work can be accomplished with an iron which can be kept constantly at a uniform temperature, and this can only be accomplished with an electric iron. The Electric Appliance Company is prepared to send a special circular of this line of goods on application.

PROTECTION AGAINST LIGHTNING.—The Garton-Daniels Electric Company, Keokuk, Iowa, states that the orders for its lightning arresters are beyond expectations, and that its business for each month of this year so far has been more than double that of the same month last year. The company regards this increased volume of business during the present dullness of trade as evidence of appreciation of the merits of the Garton lightning arresters.

THE W. H. ELLIOTT ELECTRIC COMPANY, Cleveland, Ohio, has found its system of offering to pay the freight one way from any part of the country a material help in securing several large orders of late. This concern builds armatures and commutators and rewinds and refills burned-out armatures, commutators, and also repairs transformers, dynamos and motors. Fourteen years' practical experience in this particular line is an excellent recommendation.

MESSRS. STANLEY & PATTERSON, 32 Frankfort Street, have just issued a complete and well-compiled catalogue, which includes almost everything in the line of electrical supplies, from a push button to a complete electric light and power plant. The catalogue includes nearly 200 pages, and has a brilliant red cover, on one side of which is given a map of that section of the city in the vicinity of Stanley & Patterson's stand. The exact location of the building is marked on the map.

RAIL BONDING.—The Forest City Electric Company, Cleveland, Ohio, has just issued a neat little book on "Rail Bonding and the Protected Rail Bond." The subject is very carefully gone into, and by the aid of various illustrations the highest development of rail bonding is well shown. The book is very neatly gotten up and will be of interest to anyone who is concerned in such matters. The Forest City Electric Company has given this subject careful thought and brought it to a high state of development.

MESSRS. NIGHTINGALE, JOHNSON & CO., electrical engineers and contractors, 26 and 28 Catharine Street, Utica, N. Y., will continue in business hereafter under the firm name of Johnson & Morton, Mr. Nightingale having retired from the business. The new firm will carry on the same line of contracting work, and the manufacture of special junction boxes and switchboards. New machinery has been placed in the shop, so that the firm is now equipped to do a general electrical repairing business.

THE ONONDAGA DYNAMO COMPANY, Syracuse, N. Y., is frequently in receipt of flattering testimonials regarding its dynamos. The following is a copy of a letter recently received from the Baker Gun & Forging Company, Batavia, N. Y.: "The thousand-light dynamo that you made for us over four years ago has given us the best of satisfaction. It has not cost us one dollar for repairs in all this time, and we are more than satisfied with it." The above is particularly gratifying to the Onondaga Dynamo Company, coming as it did unsolicited.

INTERMITTENT GEARS.—The Boston Gear Works has issued a treatise on intermittent gears, which will be of much interest to mechanics. Any mechanic who wishes to reduce complicated movements to the most simple form will find a great deal of help and information in this book. Every known and practical form of gearing is described and well-illustrated, and the pamphlet will be of great value on account of the light thrown on the peculiar mechanisms of the various forms of gears. The book also gives some very valuable tables. A charge of fifty cents per copy is made, and, considering the amount of matter contained in the book, it is a very low price.

ARMINGTON & SIMS ENGINES IN PENNSYLVANIA.—Messrs. F. E. Bailey & Co., Philadelphia, Pa., representing the Armington & Sims Company, Providence, R. I., have recently closed contracts as follows: The Edison Electric Illuminating Company, Bellefonte, Pa., one 130-hp and one 160-hp engine, to be fitted with the new regulator; the Midvale Steel Company, Philadelphia, one 170-hp engine of the new self-oiling type, fitted with the new regulator; the Altoona Electrical Engineering & Supply Co., Altoona, Pa., one 130-hp new type special railway engine, with new governor; also the contract for a complete electric light and pumping plant for the Country Club at Harrisburg, Pa.

MESSRS. SHEEHAN & HEWITT is the title of a copartnership just formed in Newburgh, N. Y. The members of the firm are Mr. William A. Sheehan and Charles E. Hewitt, and these gentlemen have combined to carry on a general business of electrical engineering and contracting. They will give special attention to the installation of complete electrical plants, dynamos,

motors, engines, boilers and general electrical construction work. Mr. Sheehan has been in the electrical business for several years, having for some time been electrician and manager of the old Newburgh Electric Light & Power Company. He afterward established and managed the business of the Hyer-Sheehan Electric Motor Company, from which concern he withdrew about a year ago. Mr. Hewitt has had a thorough technical education in electricity, and received the degree of Master of Mechanical Engineering at Cornell University. He became associated with the Hyer-Sheehan Motor Company two years ago, but retired from that firm on May 1 to enter into the new partnership.

MR. O. MORAN, the inventor and manufacturer of the well-known Acme telephone equipments, formerly of 91 Liberty Street, has removed to 112 Liberty Street, where, with more commodious quarters and improved facilities, he expects to meet the many demands for these telephone appliances. Mr. Moran has lately developed some entirely new devices and methods of operation, and expects to shortly increase his business and financial connections in order to push independent telephony to the fullest extent. Several recently obtained franchises controlled by Mr. Moran for towns in this State are simply awaiting further development before being actively operated. The new transmitter is worthy of the highest praise.

THE AMERICAN ENGINE COMPANY, Bound Brook, N. J., has just begun the shipment of its new direct-connected generating plants, in which the American-Ball engine is combined with its new line of six-pole generators. It is now installing a 75-kw plant at No. 7 East Seventeenth Street, New York, in the building of Deutsch Brothers, and a 35-kw plant in the building of the "Evening Wisconsin," Milwaukee. In addition to this it has orders from the Philadelphia "Enquirer" for a 100-kw plant; the Buffalo "Evening News," a 35-kw plant; the Phelps Publishing Company, Springfield, Mass., two 35-kw plants; the New York "Tribune," a 75-kw plant, and the World's Dispensary Medical Association, Buffalo, a 25-kw plant.

STANDARD AIR-BRAKES.—The Standard Air-Brake Co., N. Y., has closed contracts with the Dighton, Somerset & Swansea Street Railway Company, Taunton, Mass.; the Commonwealth Street Railway Company, Boston, Mass., and through its foreign agents, for air-brakes for the continent. The company is also supplying to the Pennsylvania State College, Department of Electrical Engineering, for use on its experimental line, which has been built to teach the students practically, a complete working outfit, showing the operation of the "Standard" system. The new electric motor cars on the Sydney, New South Wales, street railway line are fitted with Standard air-brakes. The grades on this line rise as high as 7.69 per cent.

MESSRS. CHARLES H. BESLY & CO., 10-12 North Canal Street, Chicago, have just issued their 1897 catalogue of fine tools, etc. The book is in a convenient form for desk, pocket and tool chest, and contains 300 pages of live matter relating to manufacturers' and machinists' hardware, brass and copper in rolls, sheets, rods, tubes and wire, fine tools for metal workers, seamless tubes in brass and copper, platers', polishers' and grinders' supplies, and hardware supplies in general. The catalogue is very liberally illustrated with half-tone pictures and diagrams and contains very complete descriptions of the machines and apparatus listed. The index or finding list contains over 1,700 subheads. A copy of this catalogue will be sent to any address upon application.

AMERICAN IMPULSE WHEELS.—The American Impulse Wheel Company, New York, has just issued a very handsome catalogue describing the perfect American Hurdy-Gurdy water-wheel manufactured by it. The American impulse wheel is the invention of Mr. F. M. F. Cazin, Hoboken, N. J., and was described and illustrated in a recent issue of THE ELECTRICAL WORLD. The catalogue contains a very valuable table of pressure equivalents, horse-power, quantity of water and number of working revolutions under heads of from 9 to 2000 feet, and gives besides a great deal of other valuable data concerning modern hydraulics. A complete table of contents is given, and the book will no doubt serve as a very handy work of reference on matters pertaining to this important subject.

THE PEERLESS RUBBER MANUFACTURING COMPANY, 16 Warren Street, New York, manufacturer of the well-known "Rainbow" packing, is a well-established concern, having been founded in 1872 by Charles Foster, Jr., and Henry S. Winans, with whom was associated as superintendent, Mr. John H. Deming, who has continued in that position ever since. Mr. Deming has had thirty-four years' continuous experience in the manufacture of fine mechanical rubber goods, which experience places him in the front rank of manufacturers. The "Rainbow" packing was suggested by Mr. C. H. Dale, who was then general sales agent of the company, and the manufacture of this packing has been continued ever since by Mr. J. H. Deming. The favor with which this packing is regarded in the trade is sufficient evidence of its excellence.

THE RIDGWAY DYNAMO & ENGINE COMPANY, Ridgway, Pa., has recently received the following orders for its well-known engines: One compound condensing engine, for the Ithaca Street Railway Company, Ithaca, N. Y. (second order); one automatic engine, direct-connected to a 25-kw Thompson-Ryan generator, for the Hart Memorial Library, Troy, N. Y.; one engine for the Southwestern Coal & Improvement Company, Parsons, Kan.; one engine for the Keystone Coal Mining Company, Lawsonham, Pa.; two engines, direct-connected to two 75-kw Thompson-Ryan generators, for the Cambridge Springs Company, Cambridgeboro, Pa.; two engines, direct-connected to two 100-kw generators, for the Metropolitan Theatre, Buffalo, N. Y.; two 250-hp engines for the Berwind-White Coal Mining Company, Osceola Mills, Pa.; one engine, direct-connected to 20-kw generator, for the North Texas Bank Building, Dallas, Texas; one engine, direct-connected to 8-kw generator, for the Coronado Apartment House, New York, and one 80-kw belted generator for the American Bridge Company, Chicago, Ill.

THE MITCHELL TEMPERED COPPER COMPANY, Corry, Pa., makes a tempered copper especially adapted for trolley companies that refill their own commutators. This company claims for its products purity of metal and excellence of workmanship. The copper requires no filing or planing in setting up in commutators. A large Western electrical concern, wishing recently to ascertain the accuracy of the company's work, measured a small commutator bar with a micrometer. The result showed the exceedingly small variation of .004 of an inch in gauge, and the test resulted in a large order. Many instances of like experience could be cited. These castings are guaranteed to be free from blow-holes or sand-washing, even to the size of a pin point. Only Lake Superior Calumet-Hecla ingot copper is used in their manufacture. The company is willing to place its goods in practical competition with all makers of tempered copper. Capt. Dan. Mitchell, the originator of the Mitchell tempered copper, was, during 1890, connected with the Mitchell-Brandt Tempered Copper Company, at Erie, Pa., which originated the celebrated "M. & B." copper castings. Mr. J. G. Ruhl, who holds the position of treasurer and secretary of the Mitchell Tempered Copper Company, is a well-known railroad man.

"THE AMERICAN EDUCATOR" is the title of a new work of four volumes which will soon be issued by the Syndicate Publishing Company, Philadelphia, Pa. It will be a general encyclopædia, thoroughly up-to-date, most of the important matter, statistics, etc., having been compiled within the past six months. The work will treat some 65,000 separate encyclopaedic subjects, and will contain over 75,000 geographical names and places, and 15,000 biographical sketches. A trained force of more than 200 scientists and educators and unlimited financial means have been employed in the preparation of this work. The live topics of the day have received special consideration, and the electrical department is said to be particularly complete, having been brought down to date. All the latest advances in other departments of science and mechanical skill are fully treated and illustrated. The biographies are largely those of living men, and the statistics are in part the result of about 30, 000 special references received since January 1, 1897. The illustrations include 700 subjects in seventeen colors. A special offer is made for advance orders for this work, thus affording an excellent opportunity to obtain a complete, up-to-date encyclopædia at a reasonable price.

ONE MONTH'S BUSINESS IN MOTORS AND GENERATORS.—The April sales of the Triumph Electric Company, Cincinnati, Ohio, make an excellent showing, having been as follows: Buffalo Cold Storage Company, Buffalo, N. Y., one 80-kw 550-volt generator, one 15-hp 500-volt motor; two 10-hp 500-volt motors; one 3-hp 500-volt motor; J. H. Curran, Cincinnati, Ohio, one 5-hp 220-volt elevator motor and controller; Masonic Temple Association, Detroit, Mich., two 50-kw direct-current generators, one 7½-kw direct-current generator; E. D. Williams, Los Angeles, Cal., one 1-hp 500-volt motor; Messrs. Thebaud Bros., New York, one 1½-kw 120-volt S. S. generator, one 3-kw 120-volt generator; Central Iron Works, Quincy, Ill., one 5-hp motor, 500 volts; United Bank Building, New York, N. Y., one 45-kw generator, 125 volts; Nashville, Tenn., one 5-hp elevator motor; Kentucky Machinery Co., New Albany, Ind., one 10-hp motor, 220 volts; Pearsall & Chamberlain, Brownsville, Pa., one 1½-kw S. S. generator; Krey Packing Co., St. Louis, Mo., one 15-kw 125-volt direct-current generator, one 1½-hp 110-volt motor; Bluffton, Ohio, one 80-kw 250-volt generator, central station; Wm. Freed, Nashville, Tenn., one 3-kw generator; A. N. Kellogg Newspaper Company, Cincinnati, Ohio, one 25-hp 125-volt motor; Warner Elevator Manufacturing Company, Cincinnati, Ohio, one 5-hp 220-volt elevator motor and controller, one 7½-hp 500-volt motor and controller; Cincinnati Ice Manufacturing & Cold Storage Company, one 15-kw 120-volt generator; R. S. Witherspoon, Louisville, Ky., one 3-kw generator; St. Louis Brewing Association, St. Louis, one 37½-kw 120-volt direct-current generator; St. Louis Brewing Association, St. Louis, one 37½-kw 120-volt direct-current generator; Waterloo & Cedar Falls Rapid Transit Company, Waterloo, Ia., one 150-kw belted generator.

THE WALKER COMPANY, Cleveland, Ohio, has recently closed the following contracts for generators: C. C. Chandler, Chicago, one 100-kw belted; J. C. Hubinger & Co., Keokuk, Iowa, one 200-kw belted; Northfoss & Sons, Wadena, Minn., one 75-kw belted; Naugle, Holcomb & Co., Chicago (for Suburban Railway, Chicago), one 250-kw and one 400-kw direct connected; Baltimore & Ohio Railroad Company, one 300-kw booster; Foresters Building, Toronto, five 50-kw direct connected; Queens Insurance Company Building, New York, one 100-kw and one 50-kw direct connected; Wendell & MacDuffie, New York City, one 75-kw belted; Ludwig Baumann, New York City, two 75-kw and one 30-kw direct conneeted; Troy Gas Company, Troy, N. Y., two 150-kw belted; Municipal Gas Company, Albany, N. Y., one 200-kw belted; New York & Staten Island Railroad Company, one 800-kw direct connected; Memphis Street Railway Company, Memphis, one 800-kw direct connected; Columbia Electric Light & Railway Company, one 150-kw belted; J. E. & A. L. Pennock, New York City (for the new St. James Building), two 75-kw, one 50-kw and one 25-kw direct connected; Hon. J. W. Hinkley, Poughkeepsie, N. Y., one 50-kw direct connected; Penn Yan, Keuka Park & Branchport Railway Company, two 150-kw belted; Agency Walker Company, Paris, France, one 100-kw and two 150-kw belted; Bagnall & Hilles, Yokohama, Japan, two 100-kw belted. In nearly all of these cases the Walker Company has supplied the necessary switchboard apparatus. Contracts for motors and car equipment have also been closed recently as follows: C. C. Chandler, Chicago, Ill., four No. 4A double equipments (8 motors); Naugle, Holcomb & Co., Chicago, fourteen No. 10 double equipments (28 motors); North Side Street Railway Company, one No. 3 double equipment (2 motors); D. M. Robbins, Minneapolis, Minn., one No. 5 double equipment (2 motors); Agency Walker Company, Paris, five No. 3 double equipments (10 motors), eighteen single No. 3 equipments (18 motors) and twenty-one No. 4A double equipments (42 motors); Bagnall & Hilles, Yokohama, Japan, twelve No. 3 single equipments (12 motors).

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

Annual Report of the Erie Telegraph & Telephone Company.

[*From The Boston Transcript.*]

The fourteenth annual report of the Erie Telegraph & Telephone Company, covering results of operations for the calendar year 1896, is an unusually interesting and valuable publication. The American Bell Telephone Company's interest in the management of the sub-companies is represented by Mr. John E. Hudson, Mr. Thomas Sherwin, of Boston, and Mr. David B. Parker, of Buffalo. Mr. Levi Sprague is president of the Erie and of the sub-companies; Mr. Charles J. Glidden, vice-president; Mr. George B. Perham, secretary; Mr. Charles A. Grant, treasurer; Mr. James P. McKinstry, general manager, with Messrs. Abner

LINES OF THE NORTHWESTERN TELEPHONE EXCHANGE COMPANY OPERATED BY THE ERIE TELEGRAPH AND TELEPHONE COMPANY.

pamphlet giving full details of the operations, plants, etc., of the three sub-companies, with maps of territory and cuts of buildings, in every way a highly lucid and creditable S. and Charles E. Adams, Charles J. Glidden, J. W. C. Pickering, Asa C. Russell and Levi Sprague, of Lowell, Mass.; H. D. W. Burt and H. F. Stevens, of New York;

A. Gove and Wesley C. S. Tuckerman, of Boston, and Harvey A. Whiting, of Wilton, N. H., directors.

The increase of subscribers in 1896 was 21,389, against 18,591 in 1895, and 16,174 in 1894, the net increase for 1896 being 2,798. The increase since 1883 is from 5,991 to 21,389. The total number of metallic circuit subscribers is 2,061; total exchanges, 65, against 63 in 1895 and 56 in 1894. Expenditure on the plant in 1896 was: New construction, $828,317.65; maintenance, $199,823.78; real estate, $206,273.07; total, $1,234,414.50. Since 1883 a total of $4,839,459.96 has been spent on the plant, exclusive of cost of original properties and rights. In this period gross earnings have aggregated $10,745,911; expenses, $6,927,918; net income, $3,817,993. The Erie has paid fifty-three dividends, and No. 54 has just been declared, payable May 17. The company owns lands and buildings valued at $440,000 in eight cities, with others building or contemplated. A total of 43,032 miles of wire is in operation. The 1897 requirements are estimated at $500,000 for new construction; $200,000 for real estate; total, $700,000.

LINES OF THE SOUTHWESTERN TELEGRAPH AND TELEPHONE COMPANY OPERATED BY THE ERIE TELEGRAPH AND TELEPHONE COMPANY.

Illustrated Record of Electrical Patents.

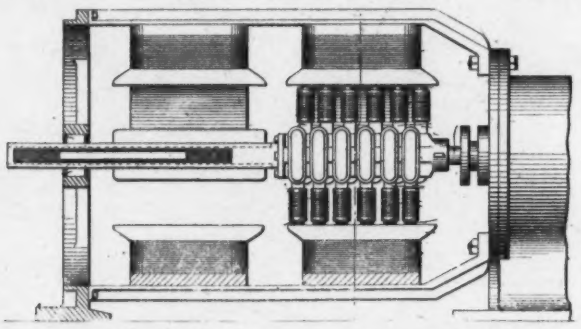
UNITED STATES PATENTS ISSUED APRIL 27, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

581,263. ELECTRICAL CONNECTION; H. P. Brown, New York, N Y. App. filed Feb. 2, 1895. An electrical connection consisting in the combination with two conductors jointed together and furnished with a hollowed or confined space or receptacle between them, means for clamping or binding the two conductors firmly together, and a plastic alloy or amalgam confined in the space or receptacle between the conductors and forming an electrical connection between the conductors.

581,264. TRACK CLEANER; W. M. Brown, Johnstown, Pa. App. filed July 18, 1896. In combination with an electric railway car and current-collecting devices beneath the car, a current-conveyor in electrical connection with the source of supply, magnets carried by the car, the current-conveyor being within the magnetic fields of said magnets, a second set of magnets carried by the car, the current-conveyor being without the field of said last-mentioned magnets.

581,281. UNDERGROUND TROLLEY CONDUIT; J. D. Griffen, New York, N. Y. App. filed May 22, 1893. An underground trolley conduit comprising a main trench formed of metal yokes set at intervals apart in



No. 581,366.—Electric Generator.

the ground, the intermediate space being closed to form a continuous main trench, slot-rails mounted on said yokes and a diaphragm forming a trolley casing at its bottom and sides and fastened in and along the main trench, the said trolley casing having an opening or slot at its top near one side of the main trench and a separate guard-plate secured to the structure above the trolley casing, the adjacent edges of the said guard-plate and the diaphragm of the trolley casing being in substantially the same horizontal plane and offset, or spaced therefrom to form a second or interior slot, in combination with a trolley arm bent to form an angle below said guard-plate, and also bent to form another angle above the upper edge of the trolley casing.

581,283. SECONDARY BATTERY; V. M. Harris, Chicago, Ill. App. filed July 6, 1896. A storage battery comprising an outer retaining case or cup, an outer cylindrically-shaped gauze-like body constituting the negative element, an inner cylindrical porous cup, a central cylindrical positive element, having a smooth, unbroken surface, a mass of active material annular in cross-section interposed between the walls of the porous cup and the surface of the opposite element, the two elements and the active material arranged symmetrically about a common axis and a suitable fluid in the retaining cup.

581,298. REGISTERING MECHANISM; W. H. McFall, Philadelphia, Pa. App. filed Feb. 6, 1897. The combination with a register or counter, of a rotating cam engaging with the gearing of the counter to actuate the same, and a motor for rotating said cam.

581,327. ELECTRIC GAS LIGHTER; L. L. Borradaile, Philadelphia, Pa. App. filed Dec. 23, 1896. In a pendant gas burner the following elements in combination: A gas burner, a gas valve for the same, a valve-operating lever and a spring, one end of which is fixed relatively to the burner, and the other end of which is free and acts upon said valve-operating lever in one of its positions in the plane of and against the direction of its then possible movement, and in the other of its positions at an angle to the plane of its then possible movement.

581,340. MAGNETO-ELECTRIC MACHINE; E. B. Cutten, Atlantic Highlands, N. J. App. filed Feb. 12, 1897. In a magneto-electric machine, the combination with the normal armature circuit and driving mechanism for the armature, including a gear wheel, of a spring-contact device adapted to engage the teeth of the gear wheel during rotation thereof, and a shunt circuit for the armature circuit, including said wheel and spring-contact device.

580,350. TELEPHONE INSTRUMENT; J. E. Keelyn, Chicago, Ill. App. filed Jan. 5, 1897. In a telephone instrument, a magnet carrying a coil, a disc-screw threaded on its outer surface rigidly mounted on said magnet and an outer shell carrying a diaphragm and having on its inner surface a screw-thread into which said threaded disc fits, whereby the magnet may be adjusted longitudinally toward or from the diaphragm by turning it in the shell, and means whereby the magnet may be clamped into any desired position.

581,363. GAS VOLTAMETER; H. A. Naber, London, England. App. filed March 30, 1896. The combination with electrodes and vessels containing said electrodes and having openings for escape of gas developed therein, and a burette open below and having said opening displaced laterally of the axis, the said burette being adapted to be lifted and rotated in order to be brought over or away from the openings in the gas-developing chambers.

581,366. ELECTRIC GENERATOR; C. C. Poole, Evanston, Ill. App. filed Feb. 26, 1894. The combination with a plurality of reciprocating prime movers subject to the action of steam or gas under pressure of means in mechanical connection with said prime movers by which reverse movement thereof is caused to take place at equal intervals of time, and an electric generator consisting of a plurality of generator sections, the moving parts of which are severally in rigid mechanical connection with said prime movers, the moving part of each generator section being located in such relation to the stationary part with which it co-acts in the production of current as to produce electric inductions or impulses during the time said reciprocating part is moving through the middle part of its stroke only.

581,368. SUPPORT FOR ELECTRIC RAILWAY CONDUCTORS; E. D. Priest, Schenectady, N. Y. App. filed Aug. 28, 1896. A support for a tubular conductor consisting of a clamp having separable members adapted to engage with the inner surface of the conductor, and means for separating the members of the clamp after they are placed in position.

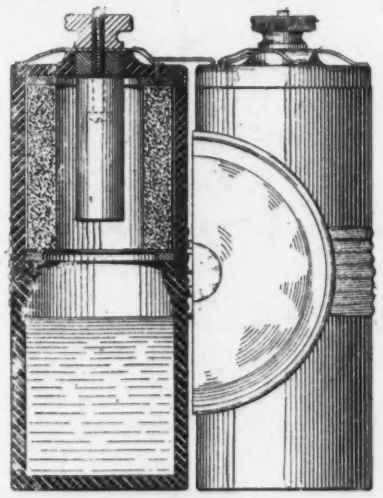
581,406. TELEPHONE RECEIVER; W. J. Morton, New York, N. Y. App. filed May 15, 1895. A telephone receiver having a soft-iron diaphragm located between two magnets, one of said magnets being a permanently-magnetized disc and provided with perforations.

581,411. PRINTING TELEGRAPH; J. Burry, Long Island City, N. Y. App. filed June 27, 1896. The combination with a shaft, a loose gear thereon, a spring fast at one end to said loose gear, a spring fast at one end to said shaft, friction devices connecting said springs, and intermittently-acting means for turning said shaft to wind up the spring fast thereon.

581,426. PRIMARY BATTERY; R. R. Moffatt, Brooklyn, N. Y. App. filed Sept. 1, 1896. A primary battery comprising a metal frame having a plurality of openings and a plurality of independent battery vessels, each consisting of two cups, having rims secured in the openings of said frame.

581,430. SEMAPHORIC ELECTRIC SIGNAL; R. S. Roberts, Philadelphia, Pa. App. filed Oct. 16, 1896. In a semaphoric electric signal, the combination of a support with a signal-box having a suitable sectoral opening, a frame supported within said box, an electro-magnet adjustably borne by said frame, the helices of said magnets having proper terminals adapted to receive the ends of an electric circuit, a rocking shaft adjustably journaled in said frame, an armature adjustably attached to said rocking shaft and operatively presented to the poles of said magnet, semaphoric arms attached to said rocking shaft, adjustable means for limiting the oscillation of said arms, whereby one arm alone is visible through said sectoral opening when said magnet is energized, and another arm alone visible through said sectoral opening when said magnet is demagnetized.

581,446. ELECTRIC CALL; H. C. West, New York, N. Y. App. filed July 29, 1896. An electric call comprising two separate sources of electric current located at two electrically-connected stations, one at each station, said



No. 581,426.—Primary Battery.

sources of electric current being normally connected in opposition to each other, a signaling instrument at each station, a reversing switch at each station and connections from each of said reversing switches excluding the signaling instrument at the same station, whereby upon the actuation of the switch the sources of electric current are connected in series to actuate the signaling instrument at the other station.

581,455. MOUNTING FOR FUSES; W. W. Dean, St. Louis, Mo. App. filed Sept. 19, 1896. In a fuse terminal, the combination of an end and arms with an ear to which the fuse wire may be attached, located between said arms and bent at an angle thereto.